The 407th Symposium on Sustainable Humanosphere

The 4th Asia Research Node Symposium on Humanosphere Science

Date: December 26-27, 2019
Venue: Nanjing International Conference Hotel, China

URL: http://www.rish.kyoto-u.ac.jp/arn4/

Organized by

生存圏研究所
Research Institute for Sustainable Humanosphere, Kyoto University

南京林業大学
Nanjing Forestry University

Preface

The Research Institute for Sustainable Humanosphere (RISH) of Kyoto University launched a new program called the Humanosphere Asia Research Node (ARN) in 2016. This program aims to strengthen its function as a hub for international collaborative research and foster innovation in the field of humanosphere science, with the ultimate goal of delivering solutions to global-scale problems. ARN integrates various facilities and human networks in ASEAN region and Japan for consolidating the international collaborative research on “Sustainable Humanosphere”.

One of the major actions is the organization of the ARN symposium, which aims to share the concept and recent advances of Humanosphere Science, thereby fostering students and young researchers who will sustain and expand the new science. In the 4th conference, the symposium was realized by organization with Nanjing Forestry University and RISH, longtime cooperative partner institutions since October 25th, 1996.

The ARN Symposium covers scientific and technological advances principally in the fields of agricultural life science, wood and timber science and engineering, and radio atmospheric science and engineering together with other related sciences contributing to creating “Sustainable Humanosphere”.

We are delighted to announce that 285 attendees join this 4th symposium at International Conference Hotel in Nanjing, China, which runs on December 26-27, 2019. including 35 oral and 148 poster presentations.

Organizing committee of the ARN symposium is deeply grateful to Nanjing Forestry University for organizing the local executive committee. Our acknowledgments are extended to Nanjing Forestry University, Kyoto University, for special financial support to this symposium.

Chairpersons of the 4th ARN

Junji Sugiyama

Research Institute for Sustainable Humanosphere, Kyoto University

Changtong Mei

College of Materials Science and Engineering, Nanjing Forestry University

Honorary Chairperson of the 4th ARN

Hao Wang

President of Nanjing Forestry University

The 4th Asia Research Node Symposium on Humanosphere Science

Date: December 26-27, 2019
Venue: Nanjing International Conference Hotel

December 26 (Thu)

09:30- **Opening Ceremony**
Chair: Junji Sugiyama (RISH, Kyoto University)
Opening address

Takashi Watanabe
Director of Research Institute for Sustainable Humanosphere (RISH), Kyoto University, Japan

Hao Wang
President of Nanjing Forestry University, China

Photo Session

Coffee break

10:30-12:00 **Short Poster Presentation – Elevator Speech**
Chair: Tatsuhiro Yokoyama

Lunch

Session A1: Bio-Diversity
Chairs: Lingfeng Mao
13:30-14:00 O-A1-1

Bigdata based Insect Biogeography Facing the Anthropocene
Shengbin Chen

14:00-14:30 O-A1-2

Multidimensional diversity patterns and assembly mechanism of amphibians along an elevational gradient: a case study from Mount Emei, China
Xiaoyi Wang, Junhua Hu

14:30-15:00 O-A1-3

Phenological patterns and phenological responses to climate change across biogeographical regions of China
Yanjun Du, Lingfeng Mao, Zhuqiu Song, Keping Ma

15:00-15:15 Q&A

Session B1: A new horizon of humanosphere science and humanity
Chairs: Shengcheng Zhai and Suyako Tazuru
13:30-13:50 O-B1-1

The Beginning of Use of Evergreen Oak Tree in East Asia
Yumiko Murakami

13:50-14:10 O-B1-2

Traditional Techniques In Maintaining Japanese Wooden Architecture
Rie Nakayama

14:10-14:22 O-B1-3

Wood Supply in Yayoi Period
Kosuke Tsurugi

14:22-14:34 O-B1-4
Two-dimensional MFA mapping and its potential for wood classification
Yusuke Kita, Junji Sugiyama
14:34-14:54 O-B1-5
Exploitation of the excavated wood from archaeological sites
Shuzhi Wang
14:54-15:14 O-B1-6
Cell Wall Deterioration of Waterlogged Wooden Artifacts
Juan Guo, Liuyang Han, Maomao Zhang, Yafang Yin

Coffee break

Session A2: Research of space electromagnetic environments in Asia
Chairs: Xiaohua Deng and Hirotsugu Kojima
15:45-16:10 O-A2-1
Observations of low frequency electromagnetic waves in the geospace by Chinese satellites TC-2 and ZH-1
Jinbin CAO, Zhima ZEREN, Wenlong LIU, Li ZENG and Junying YANG
16:10-16:35 O-A2-2
Conjugate observation of magnetospheric plasma waves and polar mesosphere winter echoes by Arase satellite and MST radars in both hemispheres
Yoshimasa Tanaka, Takanori Nishiyama, Akira Kadokura, Mitsunori Ozaki, Yoshizumi Miyoshi, Kazuo Shiokawa, Shin-ichiro Oyama, Ryuho Kataoka, Masaki Tsutsumi, Koji Nishimura, Kaoru Sato, Yoshiya Kasahara, Atsushi Kumamoto, Fuminori Tsuchiya, Fukizawa Mizuki, Mitsuru Hikishima, Shoya Matsuda, Ayako Matsuoka, Iku Shinohara, Masahito Nosé, Tsutomu Nagatsuma, Manabu Shinohara, Akiko Fujimoto, Mariko Teramoto, Reiko Nomura, Akira Sessai Yukimatu, Keisuke Hosokawa, Masafumi Shoji, and Ralph Latteck
16:35-17:00 O-A2-3
Electromagnetic environments around the Moon
Masaki N. Nishino, Yoshifumi Saito, Yuki Harada, Hideo Tsunakawa, Yoshiya Kasahara, Futoshi Takahashi, Shoichiro Yokota, Masaki Matsushima, Hidetoshi Shibuya, and Hisayoshi Shimizu
17:00-17:25 O-A2-4
CE-4 VLFRS Scientific Payload
Guangyou Fang, Yicai Ji

Session B2: Cellulose Nanofibers Materials
Chairs: Hiroyuki Yano and Jingquan Han
15:45-16:05 O-B2-1
Nanocellulose-Mediated Soft Composites and Their Application in Functional Materials
Jingquan Han
16:05-16:25 O-B2-2
Strong hydrogels based on cellulose or chitin nanofibers
Chuchu Chen, Dagang Li, Kentaro Abe, and Hiroyuki Yano
16:25-16:55 O-B2-3
Pulp Direct-Kneading Method for the Production of CNF Reinforced Composites
Hiroyuki Yano
16:55-17:25 O-B2-4
Trial Production vehicle utilizing CNF
Arimitsu Usuki, Naoki Obi, Yuzo Okudaira, Hiroyuki Yano

18:00-20:00 **Banquet**

December 27 (Fri)

08:30-10:30 **Poster Session**

Session A3: Wood Information: climatology and Tree ring science
Chairs: Junji Sugiyama and Biao Pan

10:30-10:55 O-A3-1
Paleoclimate study based on tree-ring width and the isotopic geochemistry; case studies of Indonesia and Myanmar
Yumiko Watanabe and Takahiro Tagami

10:55-11:20 O-A3-2
Alpine treelines on the Tibetan Plateau: an integrative understanding from xylogenesis to ecosystem
Eryuan Liang, Yafeng Wang, Xiaoxia Li, Xiaoming Lu, Shalik Ram Sigdel, Binod Dawadi, Haifeng Zhu

11:20-11:45 O-A3-3
Response of vegetation growth to extreme climate over temperate Northern Hemisphere
Xiuchen Wu

11:45-12:00 O-A3-4
Restoration of the manufacturing process on archaeological wooden artifacts by Tree-ring analysis
Yoko Ura , Yasuharu Hoshino

12:00-12:15 O-A3-5
Machine learning approaches to analyze the annual growth pattern of *Cryptomeria japonica*
Takeshi Nakajima, Junji Sugiyama

Session B3: Bioenergy and biochemicals
Chairs: Fei Wang and Yuki Tobimatsu

10:30-10:35 Session Overview and Speaker Introduction
Yuki Tobimatsu

10:35-11:05 O-B3-1
Current Researches on Biomass Energy and Biofuels in Nanjing Forestry University
Fei Wang

11:05-11:35 O-B3-2
Biomass as renewable carbon source
Yukihiko Matsumura

11:35-11:55 O-B3-3
Selective pyrolysis of biomass to produce high-quality liquid fuels and biochar
Huiyan Zhang

11:55-12:15 O-B3-4
Advanced model compounds provide new insights of lignin structures and valorization
Fengxia Yue, Minsheng Lin, Fachuang Lu, John Ralph, Runcang Sun

Lunch

Session A4: Space weather in Asia
Chairs: Tatsuhiro Yokoyama and Ercha Aa

13:30-14:00 O-A4-1
Solar flare forecasting models from the perspective of machine learning: past, present and future
Xin Huang

14:00-14:30 O-A4-2
Operational Space Weather Services in National Space Science Center of Chinese Academy of Sciences
Yanhong Chen, Siqing Liu, Bingxian Luo and Ercha Aa

14:30-14:50 O-A4-3
Current status of Ionospheric space weather and disaster prevention at Thailand
Punyawi Jamjareegulgarn, Sarun Duangsuwan, Pornchai Supnithi, Kornyanat Hozumi, Takuya Tsugawa, Mamoru Ishii

14:50-15:10 O-A4-4

Ionosonde observations of the ionosphere in West China

Chunhua Jiang, Guobin Yang, Jing Liu, Wengeng Huang, Ting Lan, Chen Zhou, Zhengyu Zhao

Session B4: Timber architectures
Chairs: Hiroshi Isoda and Zeli Que

13:30-13:50 O-B4-1

Timbers and Timber Engineering Across the Sea

Kohei Komatsu

13:50-14:10 O-B4-2

Shear performances of screw joints in timber structures

Kenji Kobayashi

14:10-14:25 O-B4-3

Lateral performance of the frame with hanging mud wall in Japanese traditional residential houses

Zherui Li, Hiroshi Isoda, Akihisa Kitamori, and Yasuhiro Araki

14:25-14:45 O-B4-4

Experimental study on bearing capacity of typical joints of Chuan-Dou style timber structures before and after reinforcement

Haibin Zhou

14:45-15:05 O-B4-5

Research and Development of Tall Timber Structures in China

Minjuan HE

Coffee break

15:45-16:20 **Closing Remarks**

Closing Address

Changtong Mei

Dean of College of Materials Science and Engineering, Nanjing Forestry University

Presentation of Oral and Poster Awards

17:00-21:00 **Dinner and Night Tour**

Poster Session (December 27 (Fri) 8:30-10:30)

P001 Self-extinguishable Transparent Wood Prepared From Polyimide
Lian Chen, Shaohua Jiang

P002 Overexpression of *PtrMYB119*, a R2R3-MYB Transcription Factor from *Populus*, Enhances Anthocyanin Accumulation and Tolerance to Drought Stress in Transgenic Tobacco Plants
Weibing Zhuang, Zhong Wang, Tao Wang, Fengjiao Zhang, Xiaochun Shu, Ning Wang

P003 Measurement of Genetic Diversity of Chinese Seashore Paspalum Resources through Morphological and Sequence-related Amplified Polymorphism (SRAP) Analysis
Hailin Guo, Yan Liu, Jianjian Li, Ling Li, Junqin Zong, Zhiyong Wang, Jianxiu Liu

P004 Developing deep learning models to automate rosewood tree species identification for CITES designation and implementation
Tuo He, Yang Lu, Lichao Jiao, Yonggang Zhang, Xiaomei Jiang, Yafang Yin

P005 Anatomical characteristics and systematic significance of *Handeliodendron bodinieri*
Xinxin Zheng, Biao Pan

P006 Species Identification and Chemical Analysis of Ancient Wood Components from the Palace Museum
Qiao Lin, Xiao-Jun Yang, Jia-Yan Luo

P007 The study on the *Dalbergia Odorifera* found in tomb of Song Dynasty unearthed in Nanjing
Xiran Li, Xinxin Zheng, Biao Pan

P008 Comparison of anatomical characteristics between the compression wood and sound wood of *Taxodium* hybrid 'Zhongshanshan'
Yang Zhao, Yujin Bi, Biao Pan

P009 Genetic method for Pterocarpus timber identification: Optimizing the DNA extraction protocol and applying DNA barcodes
Yang Lu, Lichao Jiao, and Yafang Yin

P010 Mental relaxation effects in the scents of *Lilium japonicum*, the sacred lily of Japanese traditional pharmaceutical festival
Mizuki Fujisawa, Shigeru Arai, Tetsuya Matsukawa, Shin'ichiro Kajiyama, Aya Yanagawa

P011 Effect of 6 Compound Food Anti-mould Fungicides on Mildew Resistance of Moso Bamboo
Xinyuan Tang, Mingjie Guan, and Keke Du

P012 Wood selection of traditional tea ceremony rooms in Japan
Suyako Tazuru-Mizuno and Junji Sugiyama

P013 Life Cycle Assessment of Wood Drying
He Lv, Tao Ding, and Ning Jiang

P014 Studies on the changes of chemical compositions in *P. zhennan* and *C. camphora* after degradation by brown-rot and white-rot fungi
Yujin Bi, Weiqi Leng, Biao Pan

P015 The Bonding Interface Microstructure of Straw Fiberboard Made by Keratin Modified Urea-formaldehyde Resin
Xiangjun Xu, Mingjie Guan and Keke Du

P016 Research on the physical and mechanical properties of poplar wood modified by resin impregnation and heat treatment
Chenpeng Zhao, Meihui Wu, Shengcheng Zhai, Juwan Jin

P017 Development of the new device implementing high-speed current detection circuits dedicated to particle sensors on board space missions
Motoyuki Kikukawa, Hirotsugu Kojima, Kazushi Asamura, and Yoshifumi Saito

P018 Characteristics of the Broadband Extremely Low Frequency waves through the Akebono observations with high time resolutions

Ryotaro Isoyama, Hirotsugu Kojima, Yoshiya Kasahara, and Shoya Matsuda

P019 Isolated electrostatic potential structures observed by the Arase satellite

Tomoe Taki, Hirotsugu Kojima, Yoichi Kazama, Yoshiya Kasahara, Yoshizumi Miyoshi, Iku Shinohara, Hideyuki Usui, Wang S.-Y., Tam Sunny W. Y., Ayako Matsuoka, and Shoya Matsuda

P020 Spatio-temporal distribution of the region where EMIC waves grow nonlinearly in the inner magnetosphere

Hiroki Shimamoto, Yoshiharu Omura, Yusuke Ebihara, Takashi Tanaka, and Mei-Ching Fok

P021 Preparation and properties of anisotropic cellulose nanofiber aerogels based on directional freezing technology

Yiming Chen, and Shaohua Jiang

P022 Synthesis and characterization of aminosilane grafted cellulose nanocrystal modified formaldehyde-free decorative paper and its CO_2 adsorption capacity

Wenkai Zhu, Yang Zhang, Meixiu Ji, Wei Chen and Zhe Wang

P023 Cellulose derived carbon nanofiber based catalyst for organic contaminant degradation in water media

Lu Gan

P024 Fabrication and regulation of sensitive cellulose nanocrystal films

Guomin Zhao, Yin Zhang, Shengcheng Zhai, and Mingzhu Pan

P025 Preparation and characterization of reed straw-based nanocellulose

Langsong Cheng, Shaobo Ren, Haiyang Zhang, Xiaoning Lu

P026 Study on adsorption-photocatalytic properties of cellulose nanocrystal supported ZnO nanocomposites

Yin Zhang, Liuyang Wei, Lu Gan, and Mingzhu Pan

P027 Green Preparation of Functionalized Cellulose Nanocrystal

Chenyang Cai, Zechang Wei, and Yu Fu

P028 Flame retardant-wood polyethylene composites: strain transfer and rheology

Chunxiang Ding, He Chen, Mingzhu Pan

P029 Exploration of effect of delignification on the mesopore structure in poplar cell wall by Nitrogen absorption method

Rui Liang, Yu-Hui Zhu, Liang Wen, Wan-Wan Zhao, Bing-Bin Kuai, Yao-Li Zhang, Li-Ping Cai

P030 Controlling the Distribution of Graphene in PLA for prepared Multi-functional PLA composites

Zechang Wei, Chenyang Cai, and Yangze Huang

P031 Investigation of Surface modification and dispersibility of nano-Ag/TiO_2

Jiaming Cao, Xun Gao, Lin Lin, Junyou Shi

P032 Self-assembly of a polyelectrolyte complex and its applications on flame retardancy of wood-polyethylene composites

Yanping Huang, Shuai Zhang, He Chen, and Mingzhu Pan

P033 The Research for Mechanical Performance of Modified Starch/Cellulose with Silica by Adsorption Method Filled into SBR Rubber Latex

Xiang xu Li, Mi Hyun Sohn, and Ur Ryong Cho

P034 Research and preparation of light driven and morphology regulatable shape-memory polyurethane materials based on host-guest

Jianyue Song, Leixin Deng, and Yu Fu

P035 Preparation and application of cellulose based ZnO quantum dots composite functional materials

Pei Wang, Leixin Deng, and Yu Fu

P036 Preparation and application of a kind of bio based composite material with double anti-counterfeiting function

Leixin Deng, Pei Wang, and Yu Fu

P037 Physical and Chemical Properties of Rice Seedling Substrate Mats made of Rice Straw without Using Plastic Trays

Cheng Yong, Enhui Sun, Hongying Huang, and Ping Qu

P038 Nanocellulose as Multifunctional Additives in Bentonite-Water-based Drilling Fluids

Meichun Li and Qinglin Wu

P039 Novel Fluorescence Probe of Cellulose-Based Nanocomposites for Detection of Mn^{2+} with Simpleness, Rapidity and High Sensitivity

Jun Ye, Mingming Zhang, Jian Xiong

P040 Synthesis of magnetic wood, and their magnetic and electromagnetic wave absorption properties

Lintian Yang, Zhichao Lou

P041 Study on the preparation and properties of magnetic Reconstituted Bamboo

Jie Liu, Zhichao Lou

P042 Advance in Anti-mildew Research of Bamboo

Xin Han, ZhiChao Lou

P043 Preparation and properties of Quercus variabilis shell based carbon quantum dots / chitosan / polyvinyl alcohol composite films

Kuang Wang

P044 Sustainable, Ultralight and Superhydrophobic Cellulose Nanofiber/Poly(vinyl alcohol) /Montmorillonite Aerogels as Recyclable Absorbents for Oil/Water Separation

Nannan Rong, Zhaoyang Xu, Kunjie Zhang

P045 Nanocellulose reinforced graphene/polypyrrole as an efficient counter electrode for fiber-shaped dye-sensitized solar cells

Yanan She, Dagang Li

P046 Interface reinforcement of pulp fiber based ABS composite with hydrogen bonding initiated interlinked structure via alkaline oxidation and tert-butyl grafting on cellulose

Qinrui Zhu, Dagang Li

P047 Nanocellulose reinforced hierarchical nanocomposites for high thermal performing flexible and transparent electrodes

Subir Kumar Biswas and Hiroyuki Yano

P048 Study on the biological modification of straw fibers influenced by fermentation days for pursuing quality of rice seedling

Deane Yi, Cheng Yong, Hongying Huang, Enhui Sun

P049 Multifunctional Wet-Spun Filaments Through Robust Nanocellulose Networks Wrapping to Single-Walled Carbon Nanotubes

Zhangmin Wan, Chuchu Chen, Taotao Meng, Youchao Teng, Dagang Li

P050 Poplar-Based Solar Steam Generation Device
Taotao Meng, Dagang Li

P051 Preparation and Characterization of Cottonseed Meal Adhesive for Wood-based Panels
Huidong Su, Yanfang Pang, Xiaosheng Liu, An Mao

P052 Preparation and Properties of Activated Carbon/Ultra High Molecular Weight Polyethylene Composites
Ran Wang, Dagang Li

P053 A Review of National and International Studies on Reconstituted Bamboo Lumber Anti-photodegradation Technology
Qiuyi Wang and Yanjun Li

P054 Research on 3D printing of magnetic biochar materials
Ru Li, Zhichao Lou

P055 Macropores and Robust Bamboo Charcoal Enables Efficient Interfacial Solar Steam Generation
Qian Feng, Xiangting Bo, Dagang Li

P056 Two continuous methods to fabricate micro fibrillated cellulose reinforced HDPE composites
Bowen Zhang, Dagang Li

P057 Dual-triggered CMC/Dopamine/Cystamine Hydrogels Driven by Dynamic Metal-Ligand and Redox for Self-Healing and Drug Release
Tianyu Guo, Wangxia Wang, Huining Xiao, and Yongcan Jin

P058 Preparation of Wood-based Carbon Dots and Its Application in Anti-counterfeiting Ink
Shiyu Gao, Xi Wang, Nan Xu, and Changyan Xu

P059 Metal-Organic Framework Interwoven by PANI Decorated Carbon Fiber Paper Electrode for Supercapacitors
Mengting Xu, Zhaoyang XU

P060 CoOOH nanosheets array on bacterial cellulose: A stable and efficient electrocatalyst for oxidation evolution reaction
Yu Jiang, Xiaoming Song, and Shanshan Gao

P061 A strong wood-based hydrogel with superflexibility
Yiren Wang, Qijing Wu, Dagang Li, Chuchu Chen

P062 Characterization of carbon quantum dots combined with chitosan (CS) and polyvinyl alcohol (PVA): preparation of transparent UV-barrier membrane
Nan Xu, Changyan Xu

P063 Using wood flour biochar as the support to enhance the visible-light photocatalysis performance of BiOBr for organic pollutant degradation
Aobo Geng, Changtong Mei, Lu Gan

P064 Core-shell Structure Nature Fiber Reinforced Polymer Composites via Co-extrusion Technology
Xian Zhang, Runzhou Huang

P065 Functional Interface Construction of Cellulose
Lu Yun

P066 Research of Preparation and Mechanical Performance of oil palm trunk Plywood by Phenol-formaldehyde resin impregnation
Guoqiang Zhou, Changtong Mei, Wanzhao Li, Chaozheng Liu, Chunmei Li

P067 Seasonal Changes of The Dynamic Viscosity of Xylem Sap in Poplar and Metasequoia
Liang Wen

P068 Cell and metabolite changes in forming tissues of *cunninghamia lanceolata* after dormancy

Jun-yi PENG, Rui HE, Jiang-tao SHI, Qiao LING

P069 Degradation Behavior and Protection Methods of *Cunninghamia lanceolate* Following Natural Weathering

Xinjie Cui, Junji Matsumura

P070 Basic research on paleoclimate reconstruction using teak tree-rings collected from Bago Mountains, Myanmar

Wataru Ohmuro, Yumiko Watanabe, Zhen Li, Takeshi Nakatsuka, Shinya Takeda, Takahiro Tagami

P071 Research on Cambium Activity rule in *Taxodium* hybrid'Zhongshanshan302' and *Taxodium distichum*

Congcong Li, Xinxin Zheng, Biao Pan

P072 Study on physicochemical properties and pyrolysis characteristics of torrefied cellulose

Xiaobing Cao, Jie Zhang, Dengyu Chen, Yanjun Li

P073 Maximizing enzymatic hydrolysis efficiency of lignocellulosic biomass with a novel delignification system at 100 °C

Chen Huang and Guigan Fang

P074 Study on Pyrolysis Characteristics and product quality of pickled rice straw based on TG-FTIR and Py-GC/MS

Fan Chen, Xiaobing Cao, Kehui Cen, Dengyu Chen

P075 One-pot synthesis of a lightweight effective absorber, $Fe/Fe_3O_4@C$ for electromagnetic wave energy conversion, via in situ carbonization of Fe_3O_4-lignin framework

Ru Li, Zhichao Lou, Yanjun Li, Jie Liu, Lintian Yang, Chenglong Yuan

P076 Oxidative torrefaction of cellulose and the effects of oxygen concentration on pyrolysis characteristics of its solid product

Jie Zhang, Dengyu Chen

P077 UIO-66-Cellulose composites as high ionic conductivity gel electrolyte for lithium ion batteries

Yangze Huang, Chenyang Cai, and Zechang Wei

P078 Interactions between volatiles and char during biomass pyrolysis: A case study of α-O-4 lignin model compound and functionalized graphitized carbon nanotubes

Shasha Liu, Yishuang Wu, Jie Zhang, Jianbin Zhou, Yong Huang, Shu Zhang

P079 Study on PAE Soybean Adhesive for Plywood

Jiahui Cheng, Yuanzhi Hong, Junyou Shi

P080 Study on bonding properties of poplar modified by amino resin impregnation

Qing Pan, Junyou Shi

P081 Study on Modified Melamine-formaldehyde Resin Impregnated Poplar Floor Triple Layer Decoration

Pizhi Sun, Xiaohan Hai, Junyou Shi

P082 Study on combustion characteristics of granular fuel prepared from bamboo residue

Zixiang Lin

P083 Catalytic ketonization of levoglucosan over nano-CeO_2 for production of hydrocarbon precursors

Hao Zhou, Kuan Ding, and Shu Zhang

P084 Pyrolysis Experiment and Research of Soybean Straw Briquette

Yishuang Wu, Yong Huang

P085 Research on Combustion Characteristics of Flame-retardant Wood-based Panels
Yang Liu, Deliang Xu

P086 Study on the pyrolysis mechanism of lignin based on the β-5 linkage model compound
Jie Zhang, Shasha Liu

P087 Biomass carbon high added value utilization
Yaxuan Gao, Hao Zhou, Yang Liu

P088 Preparation and application of resorcinol-furfural porous resin by soft template method
Yue Dong, Minzhi Chen

P089 Lignin-based antiviral inhibitor produced by microwave glycerolysis from sugarcane bagasse
Chihiro Kimura, Ruibo Li, Ryota Ouda, Hiroshi Nishimur, Takashi Fujita and Takashi Watanabe

P090 A mild alkaline condition for preparing pig blood adhesive with an ultrasound bath
Keke Du, Cheng Yong and Mingjie Guan

P091 Effect of leaching pretreatment with light bio-oil and acetic acid on the pyrolysis poly-generation of moso bamboo
Kehui Cen, Dengyu Chen

P092 Study on Synthesis and Mechanical Properties of Bio-polyurethanes
Mi Hyun Sohn, Xiang xu Li, and Ur Ryong Cho

P093 Facile and ultrafast assembly of cellulose nanofibers reinforced graphene/polypyrrole microfibers for high performance supercapacitors
Jing Wei, Youchao Teng, Dagang Li

P094 Microcrystalline cellulose torrefaction with the addition of calcium and magnesium salts
Hongfang Zhou, Liang Zhao, Xin Fu

P095 In-depth investigation on the physical and chemical effects of phosphoric acid pretreatment on thermal degradation of pinewood (*Pinus tabuliformis Carr.*) via fast pyrolysis
Yawen Fan, Tongtong Cui, Yan Li, Qi Li

P096 Study on Bleaching, Dyeing and Artificial Veneer of Birch
Xiaomeng Hao and Yanjun Li

P097 Structure-activity relationship of lignin for anti-UV radiation
Minsheng Lin, Fengxia Yue, Fachuang Lu

P098 The Development of Microwave Solvolysis Lignin for Antitumor Activity and Structure Analysis
Yumi Okabe, Eriko Ohgitani, Osam Mazdaand, Takashi Watanabe

P099 Electrospun Core-Shell Nanofibrous Membranes for Flexible Supercapacitor Electrordes
Sailing Zhu, Yiying Yue, and Jingquan Han

P100 Impact of alterations in lignin aromatic composition on lignocellulose utilization properties: a model study using transgenic rice plants
Yuri Takeda, Yuki Tobimatsu, Masaomi Yamamura, Toshiyuki Takano, Masahiro Sakamoto, Toshiaki Umezawa

P101 Biosynthesis and Bioengineering of cell wall cross-linking ferulates in grasses
Senri Yamamoto, Lam Pui Ying, Yuri Takeda, Yuriko Osakabe, Keishi Osakabe, Yuki Tobimatsu, Toshiaki Umezawa

P102 Characterization of lignan *O*-methyltransferases involved in antitumor biosynthesis in *Anthriscus sylvestris*
Keisuke Kobayashi, Masaomi Yamamura, Akira Shiraishi, Eiichiro Ono, Safendrri Komara Ragamustari, Masato Kumatani, Honoo Satake, and Toshiaki Umezawa

P103 Effects of Cutting Parameters on Space Distribution and morphological characters of airborne dust during MDF Milling

Yunqi Cui, Haibo Wang, Yitong Cai, Huimin Wang, Nanfeng Zhu

P104 The Effect of Microwave on Lytic Polysaccharide Monooxygenases (LPMOs) Reaction

Chen Luo, Naoko Kobayashi, Yu Iseki and Takashi Watanabe

P105 Enhancement of Enzymatic Saccharification and Xylose Recovery of Wheat Straw by a Pretreatment Process using $MgCl_2$

Dan Huo, Cheng Gu, Xiao Han, Qiulin Yang

P106 Microscopic Assisting Spectral Analysis Visualized Chemical Changes at the Cellular Level during Pretreatment

Bingwei Chen, Xinzhou Wang, Changtong Mei, Shengcheng Zhai

P107 The Influences of Different Carbon Sources on the Surface Morphology and Structures of Synthetic Carbon Microspheres

Yu-Na Kan, Sheng-Cheng Zhai, Ming-Zhu Pan, Chang-Tong Mei

P108 Simulation of GIC flowing through the power transmission network in Japan

Yuichiro Nishida, Yusuke Ebihara, Satoko Nakamura, Takashi Kikuchi, Shinichi Watari, Kumiko Hashimoto, Kentaro Kitamura

P109 Calculation of Sound Insulation for Hybrid CLT Fabricated with Lumber and LVL and comparison with experimental data

Zehui Ju, Qian He, Haiyang Zhang, Xiaoning Lu

P110 Study on synergistic flame retardancy of wood treated with zirconium phosphate / ammonium polyphosphate

Fucheng Xu, Haiyang Zhang, Yanjun Li, Jianguo Wu

P111 The continuous production techniques of arbitrary length LVL for timber architectures

Qian Zhang, Fengwen Sun, Zhoumei Tang

P112 Design of WPC integrated architectural sketch in the park

Ye Lu

P113 Aesthetic Utilization and Processing Technology of Natural Bending Wood

Dan Hao

P114 Effect of alkaline pretreat on poplar veneer for bonding performance of scrimber

Yuan ZHANG, Mingjie GUAN, Wenxian CHEN

P115 Evaluation of the Out-of-Plane Shear Properties of Cross-Laminated Timber

Yin Yang, Xiaoyan Cao, Zhiqiang Wang, Zhijun Liang, and Jianhui Zhou

P116 Study on Milling Properties of Faced Particle Board

Zhitin Liu

P117 Research and Simulation Analysis of Thermal Performance and Hygrothermal behavior of Timber-Framed Walls with different heat preservation layer

Haiyan Fu, Yewei Ding, Zheng Wang

P118 Rolling shear properties of fast-grown eucalyptus laminations

Tao Gui, Shichen Cai, Zhiqiang Wang, and Jian Li

P119 Vibration test and comfort analysis of wood diaphragm environment and impact excitation

Yewei Ding, Haiyan Fu, Zheng Wang

P120 The effect of compression on the dynamic strain distribution of OSB

Chaoyi Chen

P121 The effect of structural changes on the compressive strength of LVL

Zheng Zhang

P122 Experimental investigation of sheathing connections in wood shear wall with ply-bamboo sheathing panels

Yue Li, Wei Zheng

P123 Design and Research of C-type Wood Thin-Walled Structure in Building

Siyi Zhang, Yixin Zhu

P124 Cyclic Loading Test of 3-story CLT Structures

Xiaolan Zhang, Hiroshi Isoda, Kotaro Sumida, Yasuhiro Araki, Shoichi Nakashima, Takafumi Nakagawa, Nobuhiko Akiyama

P125 A New Production Mode Of Plate Furniture

Qing Zhu

P126 Partial compression strength of Glulam against CLT Loading

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Abstracts
Oral Session

O-A1-1

Bigdata based Insect Biogeography Facing the Anthropocene

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The Anthropocene is witnessing a loss of biodiversity, with well-documented declines in the diversity of ecosystems and species. Insect, the most diverse taxon, is also under extinction crisis caused by human and climate change. However, the knowledge on insect biogeography is limited, mainly due to poor data availability. Bigdata technology may help to improve our ability to compile and analyze the information on insect distributions and responses to human disturbance and climatic changes.

Keywords: Macroecology, Wallacean shortfall, Geographic distribution, Urbanization

O-A1-2

Multidimensional diversity patterns and assembly mechanism of amphibians along an elevational gradient: a case study from Mount Emei, China

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Identifying key ecological and evolutionary processes that determine species coexistence and community assembly is an important goal of ecology and evolutionary biology. To better understand possible drivers that influence amphibian assemblages in a humid subtropical mountain, Mount Emei, China, we quantified diversity patterns and assemblage structures. We evaluated how diversity patterns (i.e., species, phylogenetic and functional diversity) and assemblage structures changed along a 2600 m elevational gradient combining the trait-based and phylogenetic approaches with null models. The compositional, functional, and phylogenetic alpha diversity described a hump-shaped pattern along the elevational gradient whereas beta diversity (i.e., compositional, phylogenetic and functional similarity among assemblages) showed a significant distance-decay effect. Integrating functional and phylogenetic structures, we infer that competition exclusion maybe the key process to determine species assembly at low elevations; environmental filtering and competition exclusion may together determine the assembly at middle elevations due to complex assemblage structures; the environmental filtering was the key process to determine species assembly at high elevations. In light of the results obtained, it is noteworthy that evolutionary potential and species function should be of equal value to species in conservation.

Keywords: diversity patterns, assembly mechanism, elevational gradient, amphibians, Mount Emei

O-A1-3

Phenological patterns and phenological responses to climate change across biogeographical regions of China

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Documenting the patterns and drivers of functional trait distributions at large spatial scales is key to our fundamental understanding of the evolution and ecology of species interactions. However, the distribution of plant reproductive phenology and its key environmental drivers remain poorly understood. We used data from the Flora Republicae Popularis Sinicae, herbarium specimens, and photographs to explore the phenological patterns and phenological responses to climate change across biogeographical regions of China. Results showed that (1) contrasting geographical distributions and significant latitudinal, longitudinal, and elevational trends in the flowering and fruiting phenology of plant species assemblages; (2) phylogenetic signals of flowering, fruiting, and fruit development time were lower at tropical latitudes than at temperate latitudes; (3) autumn, winter and early spring warming significantly advanced spring flowering, with temperatures in autumn having almost twice as much as that of winter and early spring temperatures in a subtropical area; (4) flowering phenology of a perennial herb shows contrasting responses to global warming between humid and non-humid regions; (5) global warming increases spatial divergence in flowering dates of a perennial herb across eastern Asia. Our findings can help improve model-based predictions of present and future plant distributions.

Keywords: functional biogeography, global warming, Hopkins' law, latitudinal pattern, temperature sensitivity

O-B1-1

The Beginning of Use of Evergreen Oak Tree in East Asia

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In the Neolithic Age, at the beginning of rice cultivation, the phase of wood use changed so much. In western Japan, evergreen oak, *Quercus* subgen. *Cyclobalanopsis* began to be used on a large scale gradually.
In this presentation, I introduce an example of collaborative research of archaeology and wood anatomy on excavated woods in East Asia and show you the change of wood use focused on *Quercus* subgen. *Cyclobalanopsis*. Because its tree was hard and heavy, it was used selectively for hoes and spades to cultivate the paddy fields and to make a waterway in Yayoi period, Japan. In Japan, intensive rice cultivation culture was brought to northern Kyusyu from southern Korean peninsula in ca.2900 BC, at the beginning of Yayoi period.
At the glimpse of modern vegetation map in East Asia, the forest of evergreen oak spread also in South China. In this area, rice cultivation began much earlier than in Japan and in the Hemudu culture (ca.5000-3500 BC) in Zhejiang, various excavated woods had been researched including spades. And in the sites of Hemudu culture the evergreen oak use is also preserved. The system of wood use can be compared with that of Yayoi culture in Japan.

Keywords: Excavated woods, the Neolithic Age, Wood use, Evergreen oak, Rice cultivation

O-B1-2

Traditional Techniques In Maintaining Japanese Wooden Architecture

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Japan has long had a huge variety of techniques in preserving wooden architecture, such as architectural technologies of demolition and restoration, and re-use and relocation. In this presentation, I am going to elaborate on techniques in maintaining the surfaces of wooden building materials.
Many unpainted wooden buildings exist in Japan. The ARAI (Washing) technique is applied to keep clean the surfaces of the old wooden buildings. Additionally, the “wood-scraping” technique is used to fixe wooden buildings. Another technique called IROTSUKE (Coloring) is also used to color the surfaces of the wooden buildings corresponding to their ages.
To start off, I am going to explain the ARAI technique, the craftsmanship that has been passed down for generations, and then move on to the “wood-scraping” technique, another traditional craftsmanship. In this technique, old wooden materials from Ise Shrine are re-used. Lastly, I am going to deal with the IROTSUKE technique, Japan’s long-established craftsmanship. By presenting these time-honored maintenance techniques, I would like to introduce to you a Japanese esthetic sense of wooden buildings and our intelligence of preserving those buildings.

Keywords: ARAI (Washing), Wood Scraping, IROTSUKE (Coloring)

O-B1-3

Wood Supply in Yayoi Period

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The Yayoi period began when agriculture was brought to Japan more than 2,500 years ago. In the agricultural society, various wooden tools were used, such as farm tools, food processing tools, and agricultural festival fixtures. Therefore, the consumption of wood has increased dramatically, and it has become necessary to acquire a large amount of wood efficiently. People has acquired and spread the technique to divide large timbers with wedges and take out the board material. Restoring the lumbering process from the overcutting mark of the plate materials, they established the technique to produce longer board step by step. This is thought to be due to the improvement of the splitting accuracy and fixing method.
Another change has occurred in the production system. In Yokaichi Jikata site, the distribution of incomplete woodware corresponds to the production groups. Although only a few groups own iron axes, there have been found cut marks by iron axes on the incomplete item stored by groups who don't own ones. This shows that several groups engaged in logging activities together, and distributed there deliverables later. For these reasons, it is thought that the mass consumer society has been supported by efficient wood supply through group collaboration and technological innovation.

Keywords: Yayoi period, massive consumption, wedge splitting, group collaboration

O-B1-4

Two-dimensional MFA mapping and its potential for wood classification

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The correct identification of frequently-used and anatomically similar species, Chamaecyparis obtusa and Thujopsis dolabrata, is one of the great important tasks in terms of understanding our own wood-use cultural background. Generally, these species have been classified by the eye-observation of their difference of cross-field pitting. However, the similarities of their pitting prevent us from discriminating them smoothly. To overcome this obstacle, more robust and quantitative indices should be introduced for the softwood identification. In our study, microfibril angle (MFA) of tracheid cell wall around cross-field is utilized as the discriminant feature describing cross-field pitting quantitatively. MFA values around the periphery of cross-field were obtained as two-dimensional mapping from transverse sections through use of the degree of birefringence induced by cellulose microfibrils in cell wall. We employed image recognition techniques including convolutional neural network (CNN) for the classification of C. obtusa and T. dolabrata based on the MFA mapping images. Classification results and their interpretation will be shown in our presentation.

Keywords: Wood identification, microfibril angle (MFA), Image recognition, Cupressaceae

O-B1-5

Exploitation of the excavated wood from archaeological sites

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Wood is one of the main resources used by ancient populations. Although wood is an organic material that is easily rotted, it is well preserved in desicated, wetlogged and freezed environment. The excavated wood has both natural and social attributes. The natural attributes refer to the structural, physical and chemical properties of the wood, which are determined by the characteristics of the tree during its growth and development. The natural attributes refer to those behind the natural attributes of the wood, such as behavior of using wood, thoughts and feelings, and deep national psychology, religion and so on. By the aid of the analysis of the excavated wood from the archaeological sites, the results showed that wood relics were made from local wood by ancient populations according to the wood features, that different ethnic groups and different tomb forms used different wood for tomb funeral, and that the tomb furniture reflected ancient populations' religious ideas such as the soul of human beings with the duality of "hun (the spiritual soul)" and "po (the physical soul)"and had hierarchy in the Western Han Dynasty.

Keywords: wood exploitation, social attribute, archaeological site, resource

O-B1-6

Cell Wall Deterioration of Waterlogged Wooden Artifacts

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Archaeological wooden artifacts are prominent characteristic of the deterioration of wood cell wall components after the long-term deterioration. Herein, a multi-analytical approach to monitor the alteration in cell wall components of waterlogged archaeological wood was proposed here based on the combination of imaging FTIR microscopy, Pyrolysis-GC/MS and 2D-XRD methods. Results demonstrated that the deterioration resulted from the partial cleavages of both polysaccharide backbones and cellulose hydrogen-bonding networks, almost complete elimination of acetyl side chains of hemicellulose, the partial depletion of β-O-4 interlinks, as well as oxidation and demethylation/demethoxylation of lignin. These further caused the disoriented arrangement of crystalline cellulose, and the decrease in cellulose crystallite dimensions and crystallinity. In consequence, mesopores and macropores formed, and the number of moisture-adsorbed sites and their accessibility increased. On basis of the variations in wood cell wall components upon deterioration, an in situ, nondestructive, accurate and rapid methodology was developed to evaluate the deterioration state of archaeological wood via Direct Analysis in Real Time – high resolution Fourier Transform Ion Cyclotron Resonance Mass spectrometry (DART-MS) coupled to chemometrics. This developed methodology could accurately reflect the inhomogeneous deterioration states of archaeological wooden artifacts and avoid the interference of deposited water-insoluble sediments, in comparison with the MWC criteria.

Keywords: Waterlogged archaeological wood, cell wall structures, cellulose crystallites, porous structure, chemometrics

O-A2-1

Observations of low frequency electromagnetic waves in the geospace by Chinese satellites TC-2 and ZH-1

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The magnetic field in the geospace has two important field sources: internal (core field) and external (Magnetospheric and Ionospheric Current Systems) sources. The internal source mainly provides background DC magnetic field. The external source mainly provides short time scale magnetic field disturbances, which include ULF and VLF/ELF electromagnetic waves. The VLF/ELF electromagnetic waves mainly come from magnetosphere, ionosphere and solar wind. In addition, ground artificial VLF transmitter and some seismic activities also can emit electromagnetic waves into space. The natural VLF/ELF electromagnetic waves in the geospace include whistler mode chorus, plasmaspheric hiss, and electromagnetic ion cyclotron waves. These waves play important roles through particle-wave interaction in the magnetospheric dynamic process, particle acceleration and loss, and evolution of geomagnetic storm. Usually, search coil magnetometers are used to detect the electromagnetic waves in the geospace in the VLF/ELF frequency ranges, i.e. from several Hz to tens kHz. Both Chinese satellites TC-1/DSP and ZH-1 hold search coil magnetometers. The two missions observed plenty of VLF/ELF electromagnetic waves. The simultaneous observations of VLF/ELF electromagnetic waves and particles which improve our understanding of electromagnetic environment in the geospace.

Keywords: low frequency electromagnetic waves, search coil magnetometer. geospace, TC-1, ZH-1

O-A2-2

Conjugate observation of magnetospheric plasma waves and polar mesosphere winter echoes by Arase satellite and MST radars in both hemispheres

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Precipitation of energetic electrons with energies greater than several hundreds of keV to the polar upper atmosphere is important because it increases concentrations of nitric oxides (NO_x) and hydrogen oxides (HO_x) in the mesosphere at an altitude from 50 to 80 km, which would deplete ozone in the mesosphere, and also that in the stratosphere after downward transport during polar winter. In order to investigate the mechanism of energetic electron precipitation, we compared magnetospheric plasma waves and polar mesosphere winter echoes (PMWE) simultaneously observed by the conjugate observation with Arase satellite and Mesosphere, Stratosphere and Troposphere (MST) radars in both hemispheres, namely, the Program of the Antarctic Syowa Mesosphere, Stratosphere, and Troposphere/Incoherent Scatter Radar (PANSY) at Syowa Station, Antarctica, and the Middle Atmosphere Alomar Radar System (MAARSY) at Andøya, Norway. PMWE is radio wave scattering from the polar mesosphere observed with VHF radars during winter periods, in particular, when electron density in the mesosphere is highly enhanced due to energetic particle precipitation. We found that electromagnetic ion cyclotron waves and whistler-mode chorus waves were observed in the magnetosphere synchronously with PMWE at 55-80 km in both hemispheres. This result indicates that the interaction of energetic electrons with these plasma waves in the magnetosphere are drivers of the energetic electron precipitation, which makes the PMWE detectable.

Keywords: Arase satellite, magnetospheric plasma waves, polar mesosphere winter echoes, MST radar, PANSY

O-A2-3

Electromagnetic environments around the Moon

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The Moon does not possess intrinsic magnetic field or thick atmosphere, but non-negligible parts of its surface are strongly magnetized. These features give rise to characteristic interactions with surrounding plasma in a wide range of physical scales. Recent direct observations in orbit around the Moon by several spacecraft including Kaguya, Chang'e series, Chandrayaan-1, Artemis, and LADEE have brought us a lot of new information on the environment of the Moon. In this presentation, we will review our current understanding of lunar plasma and electromagnetic environment, focusing on the interaction between the solar wind and the Moon. As the major phenomena of the solar wind-Moon interaction, (1) direct impact of plasma onto the lunar surface and their scattering, (2) plasma interaction with crustal magnetic fields, (3) several mechanisms of solar wind entry into the wake that forms behind the Moon, and (4) their effects on wave excitation will be shown. In addition, we will present perspectives of international collaborative explorations of the Moon in a near future.

Keywords: Lunar environment, Plasma, Electromagnetic fields, Wave-particle interaction

O-A2-4

CE-4 VLFRS Scientific Payload

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The far side of the Moon is recognized as the best place for low frequency radio astronomy observations. The Moon can effectively shield radio waves from the Earth. Therefore, low-frequency radio astronomical observation at 10KHz~40MHz offers the opportunity to discover new phenomena and laws in the evolution of celestial bodies. Using the opportunity of Chang'e-4 (CE-4) exploration probe landing on the far side of the moon, a Very Low Frequency Radio Spectrometer (CE-4 VLFRS) is installed on the Chang'e 4 Lander. Its scientific mission is mainly to explore the radiating characteristics of the electric fields from radio bursts during the lunar day, and to study the ionospheric characteristics over the landing area. In this presentation, we will present the technical design and specifications of the CE-4 VLFRS payload. Also, present the preliminary scientific measurements.

Keywords: Chang'e 4 Explorer, CE-4 Lunar Lander, Lunar Farside, Very Low Frequency Radio Spectrometer

O-B2-1

Nanocellulose-Mediated Soft Composites and Their Application in Functional Materials

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The rapid development of soft, stretchable, and flexible electronic components expands the applications of electronic devices. Multifunctional electroconductive components are centrally important in developing advanced “smart” devices, such as wearable electronics and implantable biomedical devices. In contrast to the conventional rigid electronic devices, stretchable and flexible electronics are expected to cover arbitrary curved surfaces and movable parts such as the joints of a robot’s arm, thus considerably expanding the application scope of electronics. The concept of flexibility and stretchability is definitely distinct from the miniaturization trend pursued by conventional electronics, and hence has the potential to bring inspiring opportunities, particularly for large area electronics. Therefore, the adoption of moldable, flexible, and elastic materials would be a promising solution. Nanocellulose (NCC), mainly derived from the renewable biomass on earth, are particularly promising due to their attractive characteristics, such as abundance in nature, availability at low cost, nanoscale dimension, high aspect ratio, low density, high strength, intrinsic sustainability and biodegradability. We expect to explore the potential and possibility of using NCC as the advantageous building block for the functional soft electronics, such as supercapacitors, sensors, light emitting devices and micro-devices.

Keywords: nanocellulose, soft composites, functional materials, wearable electronics

O-B2-2

Strong hydrogels based on cellulose or chitin nanofibers

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Strong and flexible hydrogels have attracted increasing scientific interest due to their similar “soft-and-wet”properties with human soft tissues. Here several bioinspired, facile methods to fabricate strong cellulose or chitin-based hydrogels with designed nanofiber structures are reported. For example, by mimicking the natural sclerotization process of insect cuticles, a combination of chitin nanofiber-reinforced gelatin produced a novel hybrid hydrogel with improved mechanical properties, which further strengthened through quinone crosslinking. The tensile strength of such quinone-crosslinked hydrogels can reach as high as 2.96 MPa. Moreover, a strong wood-based hydrogel with a naturally formed aligned cellulose skeleton and polyacrylamide networks was developed with the assistance of an alkali treatment. The resulting wood-based hydrogels show an excellent tensile properties, with a tensile fracture strength and elongation of around 16.47 MPa and 16%, respectively. These studies provide novel strategy for designing strong cellulose or chitin-based hydrogels, which have potential applications in the bio-medical, tissue engineering and flexible electronic fields.

Keywords: Hydrogels, Chitin nanofibers, Cellulose, Mechanical properties

O-B2-3

Pulp Direct-Kneading Method for the Production of CNF Reinforced Composites

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The “Pulp Direct-Kneading Method”, which realizes nanoscale fibrillation of pulp fiber and uniform dispersion into resin in the production of composite materials reinforced by CNF will be introduced. Conventional methods require that CNFs are first produced and then mixed with materials such as resin, to produce resin composites. However, the Pulp Direct-Kneading Method removes these procedures creating a simple process, resulting in substantial reductions in both time and cost. We aim to establish a low energy manufacturing process centered on the Pulp Direct-Kneading Method that oversees the CNF material from the raw material to the final product. We call this manufacturing process the Kyoto Process. Kyoto process consists of five parts. That is ①selection of raw materials, ②pulping and prefibrillation, or surface fibrillation of pulp while keeping pulp shape, ③chemical modification of the pulp, ④compounding, and ⑤molding such as injection molding. Lightweight nanocomposites reinforced by CNFs have attracted interest from the automotive industries to manufacture lightweight parts contributing to low fuel consumption.
We are presently producing composites using CNF reinforced PA6 and PP.

O-B2-4

Trial Production vehicle utilizing CNF

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RISH, Kyoto University, Japan,

Cellulose nano fiber (CNF) is a new class of bio-based materials with characteristics such as high strength, low thermal expansion, low density, and is produced from various sources of cellulose sources such as plants. CNF is carbon neutral and renewable material. Nano Cellulose Vehicle (NCV) Project started in October 2016. It is expected that the reduction of weight of vehicle leads to better energy efficiency which reduces emission of carbon dioxide (CO2) from vehicles. Contribution to global warming countermeasures is expected. 22 organizations, including domestic universities, research institutes and automobile manufacturers, are currently working together to put the technology to practical use. Example of parts are intake manifolds, door trims, engine hoods. Initial evaluation results indicate the use of CNF based materials has advantage with respect to the reduction of weight of automotive parts. At the Tokyo Motor Show 2019, we exhibited a concept car using as many CNFs as possible. This time, we will also show you the promotional video that was broadcast at that time.

Keywords: CNF, global warming, automotive parts, motor show, concept car

O-A3-1

Paleoclimate study based on tree-ring width and the isotopic geochemistry; case studies of Indonesia and Myanmar

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Tree-ring width and the isotopic geochemistry are powerful tools to reconstruct past climate change because of the great advantage of exact dating. We collected teak samples from Java Island, Indonesia and Bago Mountains, Myanmar, and measured tree-ring width and the oxygen isotopic ratio. The data of tree-ring was compared with meteorological data, in order to assess the reliability of tree-ring components as climatic proxies. In the presentation, we will report the results of Indonesia and Myanmar. Moreover, we would like to introduce the previous studies on Asian dendroclimatology and discuss the future works.

Keywords: dendroclimatology, tree-ring, isotope, width, rainfall

O-A3-2

Alpine treelines on the Tibetan Plateau: an integrative understanding from xylogenesis to ecosystem

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The Tibetan Plateau hosts the world's highest natural treelines, being potentially sensitive to climate change. Based on weekly xylogenesis monitoring since 2007 on the Tibetan Plateau, we aim to answer these questions: what is the physiological mechanism for alpine treeline formation based on nature treelines on the Tibetan Plateau? Whether are there significant changes in structures and patterns of alpine treeline? Spruce, fir and juniper treelines under different macroclimate across the Tibetan Plateau were selected to monitor microclimatic conditions, weekly wood formation and leaf phenology. A network of alpine treeline plots were set up to retrieve spatiotemporal variations of alpine treelines on the Tibetan Plateau and surrounding areas. In the semi-humid treeline, the onset of cell division has a very low threshold minimum temperature that determines the length of the growing season, and drives treeline formation in sub-humid areas. In the drought-prone treeline in the northeastern Tibetan Plateau, the onset of cell division was controlled by both temperature and precipitation thresholds. As showed by treeline plots, climatic warming tended to promote an upward shift of alpine treelines at a large scale in the last 100 years. However, upslope migration rates were controlled largely by interspecific interactions in the eastern Tibetan Plateau and precipitation in the central Himalayas. It both helps to explain why many treelines have not advanced in response to climatic warming and highlights that predictions of treeline shifts based solely on climate may be misleading. In addition, the alpine treeline ecotone can be considered to be a simplified model of forest ecosystem to study global ecology and climate change.

O-A3-3

Response of vegetation growth to extreme climate over temperate Northern Hemisphere

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There tends to be increasing trend in both severity and duration of both extreme drought and heatwaves, accompanying with anthropogenic climate warming. However, the eco-physiological processes underlying the responses of vegetation growth to such changes still remain poorly established.
This study among the first discovered the differentiated drought legacy effects among forests, shrublands, and grasslands, with much longer drought legacy up to 4 years found in forests than shrublands and grasslands, with c. 1-2 years and less than 1 year, respectively. Difference in rooting system and the corresponding water uptake strategies as well as the stomatal behaviors in response to extreme drought could play dominant roles in shaping the legacy effects of extreme drought. Further, we discovered a threshold-based nonlinear response of vegetation growth to temperature exposures along with increasing temperature during growing-season. Exposures to extremely high temperature disproportionately reduced the temperature sensitivity of all three major plant functional types. Vegetation growth in high latitudinal northern Hemisphere exhibits more sensitive to that in mid-latitudinal regions. However, this threshold-based pattern in response of vegetation growth to temperature exposure can not be well captured by the current land surface models. These findings provide important insight into the physiological understandings of vegetation growth in response to a warmer and more extreme climate, and highlights crucial improvements should be further achieved to better predict the future trajectories in terrestrial functioning.

O-A3-4

Restoration of the manufacturing process on archaeological wooden artifacts by Tree-ring analysis

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This study makes it clear that it is effective to examine excavated wooden objects using a viewpoint of Tree-ring analysis through research of material wood identification by comparisons of the tree ring curves of wooden objects. There are many wooden ritual things excavated from the *Heijokyo* Site, the Capital of Japan in the 8th century. Some of them have a human shape and expression of the face, so these are called wooden effigies. Through the examination of effigies from the *Heijokyo* Site, it became clear that effigies in pairs and groups are made of the same wood material respectively. We point out that there are differences in the production process from one pair and group to others. It also became possible to the restoration of how they were used and interpretation of the site they were found because it was confirmed that the material wood is the same. This method can be applied also to researches of other excavated wooden objects if they fulfill the conditions including that their tree-rings can be seen on the cross-section or strait grain surface and they form a group from a particular context.

Keywords: archaeological wooden artifacts, the *Heijokyo* Site, Tree-ring analysis

O-A3-5

Machine learning approaches to analyze the annual growth pattern of *Cryptomeria japonica*

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Tree ring studies are important field of science, including dendrochronology, dendroclimatology and modeling the tree growth environmental response system. In general, softwood often used in these studies generates tracheids accurately aligned along the radial directions and their shape and size are known to be influenced by surrounding environment. In most cases analyses have been conducted using one parameter from one tree-ring, e.g. ring-width, density, ratio of stable isotopes, and so on. However, the information within a ring, i.e. intra-annual variability of anatomical characteristics, has been less considered as a parameter of tree ring analyses. Therefore, we investigated intra-annual anatomical features in *Cryptomeria japonica* from Ashiu Experimental Forest to extract possible relationships between climate and intra-annual ring pattern using correlation analysis combined with machine learning approaches.

Keywords: Dendrochronology, Dendroclimatology, Annual growth pattern, Machine learning

O-B3-1

Current Researches on Biomass Energy and Biofuels in Nanjing Forestry University

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Nanjing Forestry University is a comprehensive university taking forestry as the characteristic and advantage in China, and it has focused on the plantation and efficient utilization of forest resources. As a major research area, the production of biomass energy and biofuels from forest resources as well as agriculture residues has become our current strategic research direction. Current researches on biomass energy and biofuels in Nanjing Forestry University are briefly introduced in the presentation. In recent years, biomass gasification and power generation, bio-oil from lignocellulosic materials, biodiesel production from woody plants oil, as well as bioethanol production from forest and agriculture residues have been widely and effectively investigated, and some important achievements have been obtained. Research on the co-production of gas, solid and liquid by biomss gasification has been successfully carried out, and several production lines with the technical support have been established in China. Simultaneous fermentation of five-carbon sugar and six-carbon sugar has been efficiently investigated, and a pilot production line of cellulosic bioethanol with the capacity of 2000 tons per year has been built up in Heilongjiang province, China. Moreover, biodiesel production from woody plants oil catalyzed by biocatalyst has been well in progressing, and it has the potential to realize industrial production of biodiesel catalyzed over immobilized whole-cells using *Jatropha* seeds oil or waste cooking oil as feedstock.

O-B3-2

Biomass as renewable carbon source

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In the year of 2050, greenhouse gas emission is to be reduced to 80 % of the 2013 in Japan. It should be made zero sooner or later. Considering the zero emission society, there is no practical carbon source except biomass. All other renewable energy produces heat or electricity. There is no more thermal power plant or steel industry using coke from coal in operation. Considering this, and knowing that domestic biomass can cover only 5 to 10 % of Japanese primary energy supply, the use of biomass should be targeting this carbon source. There are three fields where renewable carbon is needed: jet fuel, coke, and plastic. Jet fuel has to have high energy density, which cannot be achieved by secondary battery. Steel making without coke is not possible because the product is too soft. Plastic has to be physical matter, and only renewable organics can be used. Because we cannot collect carbon from the 400 ppm of CO_2 in the atmosphere practically, photosynthesis of biomass species should be utilized. Possibility of zero emission society with the use or biomass as renewable carbon source is discussed.

Keywords: biomass, carbon, jet fuel, coke, plastic

O-B3-3

Selective pyrolysis of biomass to produce high-quality liquid fuels and biochar

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Biomass has a huge output, which is of great significance to the clean and efficient utilization of biomass and the diversification of energy structure in China. This report is related to the preparation of high-quality liquid fuel and carbon materials by selective pyrolysis of biomass. Some methods on preparing high quality oxygen-containing and oxygen-free liquid fuels by selective pyrolysis of biomass are proposed. The applicable cases of high-quality liquid fuel and carbon materials from biomass and sludge are introduced.

At present, among high-quality liquid fuels, Our research group is exploring pretreatment of biomass to prepare high stability precursor of liquid fuel, adsorption and cracking of heavy components to obtain precursor of fuel, directional oxygen transfer of oxygen containing fuel precursor to produce high quality oxygen additive, preparation of oligomer by two phase solvent system, preparation of high energy density fuel by plasma upgrading, renewable synthetic liquid fuel and so on. For the direction of high-performance carbon materials, our researches mainly include the adsorption characteristics of activated carbon Aniline modified by low temperature plasma, the preparation of mesoporous carbon by biomass volatile heavy components, the production of carbon nanomaterials and hydrogen by biomass volatile light components, etc. In addition, the calculation of material and energy balance of activated carbon preparation system is used for engineering application directions.

O-B3-4

Advanced model compounds provide new insights of lignin structures and valorization

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Lignins are complex and heterogeneous natural polymers that play essential roles in the development of plant cell walls and strongly affect their use as renewable biomaterials. As an abundant aromatic polymer, lignin valorization is becoming an important aspect of the economic viability of any lignocellulosic biorefinery strategy. However, because of the complexity and heterogeneity of lignin, its structure is neither absolutely definable nor determinable, causing difficulty at downstream valorization steps. Among various analytical techniques developed for lignins, NMR and chemical degradation methods have played very important roles for lignin elucidation. Analytical thioacidolysis, a widely used degradative method for lignin, releases diagnostic monomeric, dimeric and other larger fragments from lignins by selectively cleaving the β-aryl ether bonds. Analysis of such degraded products provides an estimation of syringyl/guaiacyl (S/G) ratios and the “condensed units”, which are important compositional information correlated to various properties of lignocellulosic biomass. Meanwhile, characterization of lignins by NMR, especially heteronuclear 2D NMR, coupled with the analysis of appropriate synthetic model compounds is a useful method to identify various lignin units by their diagnostic interunit linkages. We also devoted to synthesize more accurate model compounds that able to more precisely represent the structure of native lignin and/or degraded fragments from different chemical degradation method. Application of such model compounds can significantly enhance the lignin characterization by both chemical degradation method and NMR analysis, for example, revealed novel structures of lignin, and therefore provide new insight into lignin structure and benefit lignin valorization.

Keywords: lignin, model compounds, thioacidolysis, NMR, interunit linkages

O-A4-1

Solar flare forecasting models from the perspective of machine learning: past, present and future

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Solar flares are intense flashes of radiation emanating from the Sun. A strong solar flare and it's related eruptive events can interfere with high frequency radio communication, satellite operation, navigation equipment and so on. Furthermore, effects of solar flares could reach the earth within approximately 8 minutes. Therefore, solar flare forecast has caused long-term concern in the field of space weather.
Solar flares originate from the release of the energy stored in the magnetic field of solar active regions, the triggering mechanism for these flares, however, remains unknown. Hence the statistical and machine learning methods are used to build the solar flare forecasting model. From the perspective of machine learning, we review the solar flare forecasting models and try to discuss the possible directions to build more powerful solar flare forecasting models.

Keywords: Solar flare, Forecasting model, Machine learning

O-A4-2

Operational Space Weather Services in National Space Science Center of Chinese Academy of Sciences

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With the development of space exploration missions in China, space weather information are highly needed because it can help to prevent or reduce the risks caused by space environment disturbances. Space Environment Prediction Center (SEPC) in National Space Science Center (NSSC) was established in 1992. As the first professional organization for providing space weather services in China, SEPC has been delivering continuous daily space weather predictions for more than 20 years, and has been supplying services to many customers, such as China's manned space missions, China lunar explorations, and some specific satellite missions.
Currently, a considerable proportion of the space weather observations supporting NSSC's forecasting services come from domestic monitors. SEPC is in charge of the Space Environment Monitoring Network (SEMnet) to support operational forecasting works. Chinese Meridian Monitoring Project also supplies data for space weather modeling and applications.
NSSC has engaged in developing operational space weather models to provide accurate and objective specification and forecasting of space weather. These models describe space weather phenomena covering solar and interplanetary, geomagnetic and magnetosphere, ionosphere, and thermosphere. The models should pass the test stage before it is integrated into the operational forecasting system and operational implemented in the space weather service.

Keywords: SEPC, Space weather prediction, Operational models

O-A4-3

Current status of Ionospheric space weather and disaster prevention at Thailand

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Currently, the government institutes and KMITL are supporting ionospheric space weather and disaster prevention as frontier researches. Researchers in KMITL and other universities have cooperated to make several projects. The first project concerns space weather and irregularity observations such as a) to study the influences of solar storms on electrojet, b) to study the characteristics of plasma bubble based on VHF radar, and c) to notify earthquakes based on GNSS data etc. The second project relates to the impact mitigation and the prediction of space weather for aviation and agricultural, for example, 1) making data products and forecasting space weather based on Thailand GNSSs, 2) monitoring the range errors for GBAS and SBAS, and 3) making the prediction model for Spread-F etc. The VHF radar at Chumphon, Thailand is used to detect equatorial plasma bubble (EPB), it is thus expected to improve the EPB information and notify EPB for aviation. Chumphon VHF radar operates at frequency 39.65 MHz with 18 Yagi-antenna arrays. The installation and testing were finished within November 2019. Our new project focus on studying the unique characteristics of EPB at Chumphon, processing EPB images, and notifying the EPB in order to prevent the undesired aviation and navigation.

Keywords: Disaster prevention, equatorial plasma bubble, GNSS, ionospheric space weather, VHF radar

O-A4-4

Ionosonde observations of the ionosphere in West China

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Recently, ionosondes have been installed at Puer (22.7° N, 101.05° E), Tengchong (25.5° N, 98.5° E) of Yunnan province, Leshan (29.6 ° N, 103.75 ° E) of Sichuan province, and Zhangye (39.4° N, 100.13° E) of Gansu province by Wuhan University jointed with China Earthquake Administration and National Space Science Center to do research related to the ionosphere. It provides a great opportunity to study the ionosphere related to space weather at low and middle latitudes in West China. Ionospheric response to geomagnetic storm, spread F, F2 layer stratification, and diurnal and seasonal variations of the ionosphere in West China were investigated in this study. Ionosonde observations in this study can provide a general picture of the ionosphere in West China. It also can provide more data for space weather forecasting and related international cooperation in the future.

O-B4-1

Timbers and Timber Engineering Across the Sea

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My presentation consists of two parts. In the first part, historical stories on the timbers that were transported across the sea from *Hakata*, Japan to *Mingzhou* (明州:現在の寧波), China for repairing or re-constructing Buddhism temples during Southern Song Dynasty. In this part, the cases of *Asoka* Temple(阿育王寺) and *Tiantong* Mountain *Jingjing* Temple (天童山景徳寺) are to be introduced. The first case has been known as the contribution by the priest *Chogen* (重源), who is well known as the general director or/and producer for re-constructing the *Toudaiji* (東大寺) temple in *Kamakura* era. The latter case has been known as the contribution by the priest *Eisai* (栄西), who is currently estimated as the actual originator of *Rinzai-Zen* Sect (臨済宗) in Japan. In my presentation, these two person's activities and transportation of timbers across the sea will be explained in accordance with Chinese and Japanese references.
In the second part of my presentation, the brief history on the exchange of modern timber engineering, between RISH, Kyoto University and Timber Construction Group in Nanjing Forestry University, for learning about timber constructions will be introduced.

O-B4-2

Shear performances of screw joints in timber structures

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Screws are generally used for shear joints in timber structures. Screw joints show higher load-bearing capacity than nail joints because of a withdrawal resistance at the threaded part of the screw. It is known as a rope effect. Screws are often used after heat treatment to obtain high strength to enable driving in without pre-drilling. But some screws show brittle failure under cyclic loading because of heat treatments. These characteristics should be included for design methods for shear joints with screws.
This paper shows estimating equations for load-displacement relationship of single shear joints with screws. It also enables to estimate ultimate displacements of the joints under cyclic loading.

Keywords: Screw, Shear joints, Estimating equations, Low cycle fatigue

O-B4-3

Lateral performance of the frame with hanging mud wall in Japanese traditional residential houses

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Taking the frame with large cross-section and hanging mud wall system that applied in Japanese traditional residential houses as the research object, this article present the superposition rule of the shear resistance of the frame with mud wall that consists of the joint moment resistance, diagonal effect of the deep tie-beam, shear resistance of the mud wall and the additional rotation of the column bending based on experimental study and mechanism analysis. Based on the discussion of the disruption phenomenon of the frame specimen with and without mud wall, the analysis with calculation started from the contrast with previous joint rotational performance, and expend to the estimation of the performance of the whole frame with mud wall reference with existing theoretical calculation models. It was finally confirmed that with consideration of the interaction between joints rotation and the diagonal effect of the deep tie-beam, the global shear resistance of the frame with large cross-section and hanging mud wall can be estimated by the summation of each component resistance.

Keywords: Lateral resistance, Rotational behavior, Column to beam joint, Mud wall, Traditional timber structure

O-B4-4

Experimental study on bearing capacity of typical joints of Chuan-Dou style timber structures before and after reinforcement

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Monotonic loading and cyclic loading tests were conducted on typical full-scale joints of Chuan-Dou style timber structures. The bending performance and seismic performance of these specimens were analyzed, and the influence of different numbers and arrangement of specially-designed dampers (SDDs) on behavior of joint specimens were studied. The results indicate that bending failure occurs at the tenon root for all of those tested joint specimens, and compression deformations are reserved. The hysteretic hoop of non-reinforced joint specimen is different from that of strengthened specimens, the former have obvious pinching phenomenon. Compared to the unreinforced joint specimen, the initial rotational stiffness and bearing capacity of joint specimen reinforced by one SDD was improved under monotonic loading. However the bearing capacity and the energy dissipation were reduced under low-cyclic reversed loading. Compared to the unreinforced joint specimen, the positive bearing capacity of joint specimens reinforced by two SDDs and four SDDs were improved slightly, the increase of peak moment of the joint specimens reinforced by two SDDs and four SDDs were 52% and 19% respectively, the increase of accumulative energy dissipation were 51% and 36% respectively, the ductility were also improved. It is suggested that it is reasonable to reinforce the typical joint with two SDDs to improve their bending resistance and seismic performance of Chuan-Dou style timber structures.

Keywords: Chuan-Dou style timber structures, monotonic loading, cyclic loading, damper

O-B4-5

Research and Development of Tall Timber Structures in China

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China has a long history of timber structures. An example is the well-known Yingxian wooden pagoda, which was built in 1056 A.D. Even today, the 67-meter Yingxian wooden pagoda is still the tallest wood pagoda in China. With the development of timber structures in the world and the promotion of green buildings by the Chinese government, more and more builders and researchers have shown their interest in tall timber structures in China. This presentation will provide a systematic and comprehensive investigation into two timber structural systems, timber-steel hybrid structures and cross-laminated timber (CLT) structures. For the timber-steel hybrid structures which consist of steel moment resisting frames, infill wood shear walls and timber-steel hybrid diaphragms, quasi-static test of the hybrid diaphragms and the shear walls, the shaking table test of a timber-steel hybrid structure, the numerical model and the proposed seismic design method are presented. For the CLT structures, tests on some innovative connections, lateral performance of conventional CLT shear walls and the post-tensioned (PT) CLT shear walls, development of displacement-based seismic design procedure for CLT structures are presented. The information generated from these studies will provide the technical support for future code implementation for mid- and high-rise timber structures in China.

Keywords: Tall Timber Structures, timber-steel hybrid structures, cross-laminated timber (CLT) structures

Abstracts
Poster Session

P001

Self-extinguishable Transparent Wood Prepared From Polyimide

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As a new type of functional wood, transparent wood has a potential application in electronic devices, home decoration and other fields. However, the inherent characteristic of wood burning easily still hasn't been improved in transparent wood, which has a potential safety hazard in case of fire, limiting its use in some specific occasions. Therefore, it is an urgent problem to improve the flame retardancy of transparent wood. As a kind of polymer, polyimide has been widely used in the field of flame retardant because of its good thermal stability, mechanical properties and self-extinguishing. Herein, the high strength and flame retardancy transparent wood was prepared by combining polyimide with wood. In terms of strength, it can reach about 50 times of the natural wood. What's more, it is found that transparent wood can be ignited 5 s after it is close to the flame, but it will be extinguished within 3 s after it leaves the fire source. In addition, the heat release rate, total heat release and peak temperature of transparent wood are far lower than that of natural wood, which can achieve the purpose of flame retardant.

Keywords: Transparent wood, Polyimide, Flame retardancy

P002

Overexpression of *PtrMYB119*, a R2R3-MYB Transcription Factor from *Populus*, Enhances Anthocyanin Accumulation and Tolerance to Drought Stress in Transgenic Tobacco Plants

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MYB transcription factors (TFs) play vital roles in plant growth and development and respond to biotic and abiotic stress. However, the function of *PtrMYB119* in tobacco is unknown. In our results, transient expression assay in tobacco epidermal cells revealed that *PtrMYB119* is distributed throughout the cell with no apparent specificity. Yeast one-hybrid experiment showed that *PtrMYB119* had weak transactivation activity. The functions of *PtrMYB119* in tobacco under drought stress were investigated through the transgenic tobacco overexpressing *PtrMYB119*. The expression levels of *PtrMYB119* in leaves of transgenic tobacco is highest, and these in flower, root, stem and seed follows. In contrast to wildtype plants, transgenic plants overexpressing *PtrMYB119* showed increased accumulation of anthocyanin and endogenous abscisic acid (ABA) in tobacco plants under drought stress conditions. Moreover, transgenic plants exhibited lower malondialdehyde (MDA) content and higher activities of antioxidant enzymes when compared with the wildtype. Overexpression of *PtrMYB119* up-regulated the expression of antioxidant genes *SOD* and *CAT*, polyamine biosynthesis genes *ADC1* and *SAMDC*, protein-rich encoder *ERD10D*, and drought-responsive genes *NCED3* and *NAC/RD26* under drought stress conditions. Overall, our results suggested that transgenic tobacco plants overexpressing *PtrMYB119* enhanced drought tolerance through the accumulation of anthocyanin and endogenous ABA, enhancement of antioxidant enzymes, decrease of MDA, and up-regulation of antioxidant genes, polyamine biosynthesis genes, and drought-responsive genes. These results provide important information on the roles of *PtrMYB119* in anthocyanin accumulation and drought tolerance of tobacco plants, contributing to the elucidation of drought tolerance underlying *PtrMYB119* action. Our results will also provide references for generating drought-tolerant plants.

P003

Measurement of Genetic Diversity of Chinese Seashore Paspalum Resources through Morphological and Sequence-related Amplified Polymorphism (SRAP) Analysis

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Seashore paspalum (*Paspalum vaginatum*) is a notable warm season turfgrass. Certain germplasm resources are distributed in the southern regions of China. The objectives of this study were to investigate the genetic diversity and genetic variation of Chinese seashore paspalum resources. Morphological characteristics and sequence-related amplified polymorphism (SRAP) markers were used to assess genetic relationships and genetic variation among 36 germplasm resources from China and six cultivars from the United States. The results showed significant variation for 13 morphological characters among 42 tested seashore paspalum accessions and that the phenotypic variation coefficient was, in turn, turf height > turf density > internode length > inflorescence density > leaf width > reproductive branch height > spikelet width > leaf length > spikelet number > inflorescence length > internode diameter > inflorescence width > spikelet length. According to the morphological characteristics and cluster analysis, 42 seashore paspalum accessions were divided into six morphological types. In total, 374 clear bands were amplified using 30 SRAP primer combinations; among these bands, 321 were polymorphic with 85.83% polymorphism. SRAP marker cluster analysis showed that 42 seashore paspalum accessions were grouped into seven major groups, with a genetic similarity coefficient ranging from 0.4385 to 0.9893 and genetic distance values ranging from 0.0108 to 0.8244. The high level of genetic diversity occurred among Chinese germplasm, and the genetic distance was relatively high between chinese germplasm and cultivars introduced from America. The patterns in morphological trait variations and genetic diversity will be useful for the further exploitation and utilization of Chinese seashore paspalum resources.

Keywords: Genetic diversity, Paspalum vaginatum, Morphological character, Molecular marker

P004

Developing deep learning models to automate rosewood tree species identification for CITES designation and implementation

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Illegal logging is one of the main foci of the international community, causing deforestation, habitat loss and damage to biodiversity. The implementation of CITES to combat illegal logging and associated trade necessitates accurate and efficient field screening of wood species. In this study, deep learning models were developed to automate rosewood tree species identification. A total of 10,237 images of 15 *Dalbergia* and 11 *Pterocarpus* species were collected from the transverse surfaces of 417 wood specimens. Three deep learning models, i.e., for a mixture of the 26 species, 15 *Dalbergia* species and 11 *Pterocarpus* species, were then constructed, trained and tested with these images to discriminate between timber species. The optimal parameters of the deep learning model were analyzed, and the representative wood anatomical features that were activated by the deep learning models for the species classification were visualized. The results demonstrated that the overall accuracies of the 26-class, 15-class and 11-class models were 99.34%, 93.68%, and 88.38%, respectively. It is suggested that at least 100 high-quality images per species with minimum patch sizes of 1000 × 1000 from more than 10 wood specimens were needed to train reliable and applicable deep learning models. The feature visualization indicated that the vessel groupings and axial parenchyma were the main wood anatomical features activated by the developed deep learning models. The combination of the state-of-the-art deep learning models, parameter configuration and feature visualization provide a time- and cost-effective tool for the field screening of wood species to combat illegal logging and the associated trade and to support effective CITES designation and implementation.

Keywords: CITES designation and implementation, deep learning models, feature visualization, parameter configure, rosewood identification

P005

Anatomical characteristics and systematic significance of *Handeliodendron bodinieri*

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Handeliodendron bodinieri is a unique relict plant in China. There has been a long-time debate on the systematic classification between species in Hippocastanaceae, Sapindaceae and Aceraceae. The anatomical structure of the similar families and species with two species from Sapindaceae, three species in Hippocastanaceae and two species in Aceraceae were compared under the light microscope and scanning electron microscope. Results showed that the wood anatomical structure of *Handeliodendron bodinieri* was more similar to that of the three species in Hippocastanaceae. On the evolutionary level, *Handeliodendron bodinieri* was similar to *Aesculus* wood in terms of vessel, axial parenchyma and fiber, while the features of ray were more primitive; Compared with the wood in Harpullieae, it was more primitive in axial parenchyma and vessel, and more evolved in xylem ray; compared with the wood in Aceraceae family, *Handeliodendron bodinieri* was more evolved in solitary vessel and xylem ray, while is more primitive in axial parenchyma. which make *Handeliodendron bodinieri* a mosaic with both plesiomorphic and apomorphic character states.A UPGMA analysis showed that *Handeliodendron bodinieri* and the species from Hippocastanaceae overlap in a dendrogram in terms of wood anatomical characteristics, which is congruent with the results from molecular data and indicates that they are closely related, perhaps originating from the same ancestor. Based on the comparison of the wood anatomical structure characteristics of *Handeliodendron bodinier* and the species in Hippocastanaceae and Aceraceae, it is suggested that *Handeliodendron bodinieri* be removed from the Harpullieae of Sapindaceae and become an independent genus in Hippocastanaceae.

Keywords: Handeliodendron bodinieri, anatomy, evolution, compared

P006

Species Identification and Chemical Analysis of Ancient Wood Components from the Palace Museum

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Chinese ancient wooden architectures, such as the sculptures, palaces, monasteries in the Forbidden City, are the important carriers of culture, history and religion, which occupy a special place in the cultural heritage of China. With time elapsing, a variety of factors have contributed to the destruction and erosion of these architectures. Thus, proper conservations of these treasured wooden buildings are extremely urgent. The wood species identification provides the basis for conservation. In this study, the samples from East palace in the second court (noted as Y1) and the main hall in the courtyard (noted as Y2) were collected and sectioned. The observation from light microscope indicated that the species of Y1 and Y2 were common China-fir (*Cunninghamia* sp.) and pine (*Pinus* sp.), respectively. Fourier transform infrared spectroscopy (FT-IR) and X-ray diffraction (XRD) were used to analyze the degree of degradation. The increase of relative intensity of the peaks attributed to lignin (around 1600 cm^{-1}, 1511 cm^{-1} and 1265 cm^{-1}) from IR spectrum proved that lignin both in Y1 and Y2 was better preserved than carbohydrates. The XRD results showed that the crystallinity of samples was decrease, which might be directly caused by the degradation of cellulose. This work provided a scientific theoretical basis for the restoration of the wooden structure in the Palace Museum by identifying the tree species and understanding the changes of its chemical composition.

Keywords: Palace Museum, wood identification, chemical property

P007

The study on the *Dalbergia Odorifera* found in tomb of Song Dynasty unearthed in Nanjing

Xiran Li, Xinxin Zheng, Biao Pan

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A piece of wood was found in the ancient tombs of the Song Dynasty, which was discovered in Shimenkan, Qinhuai District, Nanjing. The tree species between the lid of the coffin and tenon was identified. Through slicing and staining, the microscopic structure of the wood is observed by the optical microscope. The chemical composition was determined by GC-MS.
The results show that: (1) The macroscopic characterization of wood: the wood is purple brown and dense. The growth ring is slightly obvious, from porous to semi porous material. It has abundant axial parenchyma, such as banded parenchyma, axial parenchyma winged-aliform, axial parenchyma vasicentric and tangent shape. The ray of wood is very thin. The ripple marks on the chord surface are obvious. The wood has a light aroma. (2) The microstructure of wood: the cross-section of wood duct is oval, solitary pore, a few 2-3 short diameter multiple pipe holes. There is some gum in the vessels. Simple perforation plates, intervessel pits alternate and vestured pits are its characteristics. The types of axial parenchyma are affluent. There are 8 or more rhombic crystals in the parenchyma cells. There are 8 or more rhombic crystals in the parenchyma cells. The wood rays are storied structure. Rays exclusively uniseriate are few. Multiple row rays are 2-3 cells wide, mainly 2-row rays, and 5-9 cells high. Vessel–ray pits with distinct borders; similar to intervessel pits in size and shape throughout the ray cell. (3) The spectrum of GC-MS shows that: consistent with the spectrum in the literature, The Identification of *Dalbergia Odorrifera* and *Dalbergia Benthami Prain* on the Basis of GC-MS Analysis, the wood has substances such as cis-Nerolidol and Nerolidol.
Conclusion: the identified wood is *Dalbergia Linn. f.* .Compared with the main *Dalbergia Linn. f.* in China, it is concluded that the wood is *Dalbergia odorifera*. This research is the earliest example of the application of *Dalbergia odorifera* in wood products. It shows that *Dalbergia odorifera* has been used in Nanjing as early as Song Dynasty, and its special properties such as smell, wood color, strength and density have been recognized to some extent.

Keywords: *Dalbergia Odorifera*, Ancient wood, Identification of species, Anatomical structure, GC-MS

P008

Comparison of anatomical characteristics between the compression wood and sound wood of *Taxodium* hybrid ‘Zhongshanshan’

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In order to explore the anatomical characteristics differences between compression wood and sound wood of *Taxodium* hybrid ‘Zhongshanshan’, By slicing and dissociating, we explore the differences between them in cell morphology and tracheid size.
The results show that the compression wood tracheids were oval and developed with thick cell walls. In consequence, intercellular spaces are prominent at the junction of tracheids in compression wood. However, the sound wood tracheids were quadrilateral or polygon. On the radial section, there are thread gaps and thread cracks embedded in the inner wall of the compression wood tracheid of *Taxodium* hybrid ‘Zhongshanshan’. Due to the influence of thread cracks, the border pit on the tracheid extend to both sides. And the tip of the compression wood tracheid should be twisted.
Average length of compression wood tracheids and sound wood tracheids were 2300.15μm and 2550.50μm respectively. The microfibril angles of compression wood is 32.14° and the microfibril angles of sound wood is 17.79° . The average thickness of the double wall thickness of compression wood is 12.42μm. The average thickness of the double wall thickness of sound woodis 5.69μm.

Keywords: compression wood, sound wood, wood anatomy

P009

Genetic method for Pterocarpus timber identification: Optimizing the DNA extraction protocol and applying DNA barcodes

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Molecular genetic methods have numerous potential applications in wood forensic identification. The isolation of wood DNA is a crucial step in the process of genetic identification for wood tissues. However, there are still practical problems with the current wood DNA extraction method. For some valuable wood samples sent for forensic identification, the amount of usage is limited. Additionally, the identification process is so long that it often cannot meet the needs of law enforcement. This study describes an optimized protocol. Studies on sample amount per extraction, digestion time and DNA binding time were carried out by a series of gradient tests. The results indicated that 300 mg is an optimal sample amount. Five hours is the optimal digestion time. Moreover, extending the time of DNA binding does not significantly increase the DNA yield from wood tissues. The DNA yields obtained using the optimized method in this study indicate good extraction efficiency, and the wood samples sent for certification were identified as *Pterocarpus erinaceus* using the barcode combination matK+ndhF-rpl32+ITS2. This method will be suitable for the broad applicability of DNA identification and conservation of global wood resources.

Keywords: DNA barcode, digestion time, droplet digital PCR, sample amount, timber identification

P010

Mental relaxation effects in the scents of *Lilium japonicum,* the sacred lily of Japanese traditional pharmaceutical festival

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Isagawa Shrine in Nara city (Japan) was established in 593 and has been responsible for hosting the Saikusa Festival, one of the most representative Japanese pharmaceutical festivals. Japanese bamboo lily, *Lilium japonicum,* is a symbolized sacred flower for this festival. A cut flower of this lily has been dedicated to the enshrined deity as a gift, which represents the medical and pharmaceutical power. For 1000 years, it had been held for the government of the day. Then, since 1881, the shrine has started to host the festival more for local people. People visit the festival with a wish of protection against diseases and disasters. In this study, to reveal the forgotten reason of a cut-flower-form gift and to seek the pharmaceutical component in this sacred flower, we have analyzed the chemical composition of its scents and made the questionnaire-based investigation to learn the influence of the flower scents on human's feeling. The result indicated that the scents of sacred flower, *L. japonicum* has relaxation effects.

P011

Effect of 6 Compound Food Anti-mould Fungicides on Mildew Resistance of Moso Bamboo

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Bamboo is ready to be affected by mold, which leads to large amounts of economic losses. In this study, six compound food anti-mould fungicides with three concentration (1.0%,1.2%,1.4%) and ultrasonic with different time (30min,45min,60min) were used to treat Moso bamboo. The results were: (1) Both ultrasonic treatment and compound food anti-mould fungicides can reduce the mildew rate of Moso bamboo. With an increase in the time of ultrasonic and the concentration of compound food anti-mould fungicides, the mildew resistance of Moso bamboo has been improved dramatically. (2) The weight loss rate of Moso bamboo increased with the increase in the time of ultrasonic. (3) When the time of ultrasonic is 60 minutes and the concentration of compound food anti-mould fungicide is 1.4%, the Moso bamboo sample has the best mildew resistance. This study indicates a new direction for the future development of bamboo mildew-proof treatment.

Keywords: Bamboo, Ultrasonic, Food anti-mould fungicide

P012

Wood selection of traditional tea ceremony rooms in Japan

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Japanese tea ceremony room is compilation of Japanese style of architecture and well-known as a representative expression of “Wabi-Sabi” the Japanese senses of beauty. For these rooms, wood identification was performed. For identification, small size of samples that were necessary for making preparation were collected carefully from deteriorated parts or cracks of wooden members so as not to change the appearance and strength. Hand-sectioned samples were observed under an optical microscope and identified on the basis of microscopic anatomical features. Some samples were too tiny to make preparation. In order to preserve these precious tiny samples for the future, nondestructive method; synchrotron X-ray microtomography (SRX-ray μCT) at SPring-8 was applied. As a result, unique wood selection peculiar to tea ceremony rooms was revealed. Further investigation of tea ceremony room in regard to wood selection would have potentials to reveal the deep culture of tea ceremony in Japan and also in Asia.

Keywords: Wood identification, Wood selection, Tea ceremony room in Japan

P013

Life Cycle Assessment of Wood Drying

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Wood drying is an essential process in wood processing. 40% to 70% of energy consumption in wood processing comes from drying process, and volatile organic compounds (VOCs), nitrogen oxides, sulfur dioxide and carbon dioxide emitted from kiln are the main causes of environmental problems. How to achieve green, energy saving and sustainable development will become new targets for wood processing industry. Therefore, in this study, Life cycle assessment is adopted to sort out and calculate the substances and energy consumption input and output of oak during conventional drying, and SimaPro software is used to evaluate environmental impact on the processed data. The results show that the total environmental impacts of $1m^3$ oak with 50mm thickness scores 53.50. In the overall environmental impacts, transportation is the most significant impact stage, accounting for 56.63%. Steam and electricity from power plants rank second and third respectively, accounting for 17.96% and 16.21% of the total environmental impacts. The last sawn timber accounts for 9.18%. Water is the only stage that has a positive impact on the environment, with negative contributions in terms of ozone depletion, radiation and minerals. This is because the water is purified and recycled into the daily activities of workers, so it has a positive impact on the environment. The results of this study can provide some ideas for similar domestic enterprises on how to achieve clean production, and more targeted improvement measures can be formulated to achieve the goal of safe production, green products and sustainable development.

Keywords: wood drying, life cycle assessment, environmental performance

P014

Studies on the changes of chemical compositions in *P. zhennan* and *C. camphora* after degradation by brown-rot and white-rot fungi

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In order to explore the chemical components of decayed *Phoebe zhennan* and *Cinnamomum camphora* , samples of these two species were exposed to white-rot fungi(*Trametes versicolor*) and brown-rot fungi(*Fomitopsis palustris*) for different durations up to 12 weeks. The degree of decay was evaluated via FTIR and XRD. For samples decayed by white-rot, there was a decrease in the intensities of lignin associated peaks(at $1236cm^{-1}$, $1510cm^{-1}$ and $1599cm^{-1}$ in *P. zhennan* and at $1236cm^{-1}$ and $1599cm^{-1}$ in *C. camphora*), indicating that lignin was degraded by white-rot. For those decayed by brown-rot, there was a corresponding decrease in the intensities of carbohydrate peaks(at $2915cm^{-1}$and $1740cm^{-1}$), indicating that cellulose and hemicellulose was degraded by white-rot. The crystallinity of white rotten wood decreased gradually after different exposure periods. The crystallinity decreased from 57.84% and 50.78% to 54.85% and 46.92% after 6 weeks of white-rot decay for *P. zhennan* and *C. camphora*, respectively, and further decreased to 49.70% and 46.95% after 12 weeks. On the other side, the crystallinity basically remained unchanged after 6 weeks of brown rotten wood for *P. zhennan* and *C. camphora*, and decreased from 57.84% and 50.78% to 49.78% and 41.30% after 9 weeks, finally increased to 52.36% and 51.24% after 12 weeks. The decrease of crystallinity indicated that the ordered structure of cellulose crystallization area was destroyed white-rot fungi and by brown-rot. Results showed that white-rot fungi mainly degraded lignin, which could destroy the benzene ring and carbon skeleton structure of lignin, while brown-rot fungi mainly degrades the side chains of cellulose and hemicellulose, and gradually degraded the crystalline area of cellulose.

Keywords: Wood decay, Chemical component, FTIR, XRD

P015

The Bonding Interface Microstructure of Straw Fiberboard Made by Keratin Modified Urea-formaldehyde Resin

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The straw residues from agriculture are renewable and environmental fiber raw material, therefore, straw fiber is often mixed with adhesives to make biocomposite. The degradation performance of the straw-based biocomposite was paid more attention to when it was applied in agriculture cultivation. At present, there are many researches on degradable biocomposites, however, the effect of adhesive distribution on bonding interface of straw fiber composites was rarely studied. And the bonding interface is very important for the study of the degradation properties of degradable materials. In this study, the degradable straw fiber boards were made by keratin modified urea-formaldehyde resin and control group, and the bonding properties of straw fiberboard was tested. More important, the bonding interface microstructure of the fiberboards was discussed by fluorescence microscope to understand the adhesion mechanism.

Keywords: Bonding interface, Keratin, Urea-formaldehyde resin, Biocomposite

P016

Research on the physical and mechanical properties of poplar wood modified by resin impregnation and heat treatment

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Modifications of poplar wood can widen its applications to outdoor and structure materials. Single heat treatment and UF (urea-formaldehyde) resin impregnation are conventional modifications, but they are short in mechanical properties and curing of resin incomplete respectively. This research used combined modification by them and DIC (Digital Image Correlation) to explore properties change in multi-angles. We grouped poplar wood, single heat treatment, single UF resin impregnation, combined modification (160℃, 180℃, 200℃). Then measured physical properties, which are oven-dry density, shrinkage and swelling, and mechanical properties, which are hardness, MOE (modulus of elasticity) and MOR (modulus of rapture). DIC was used to evidence the bending strength. We got these conclusions: (1) With increasing temperature, the oven-dry density keeps decreasing, but resin impregnation can do improve, combined modification synthesizes them and performs well. What's more, both heat treatment and resin impregnation improve dimensional stability. (2) About the hardness, the combined modification (160℃) has the highest value, 4109.7N. The combined modification (160℃) has the highest MOE and MOR among groups, which are 10893.6Mpa and 103.8Mpa respectively, the value of MOE and MOR go down with the temperature going up. Via DIC, the stress-strain appeared heterogeneity for bio-materials, stress-strain became more obvious with increasing loads, especially in the direction of loads. It displayed pulling stress in the upper part and compressive in the bottom in the Y axe, while in the X axe, it is completely opposite. And combined modification (160℃) has the minimum stress-strain value and range, which evidence the experimental results.

Keywords: Poplar wood, combined modification, physical properties, mechanical properties

P017

Development of the new device implementing high-speed current detection circuits dedicated to particle sensors on board space missions

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Plasmas filling the space are quite faint. Ions and electrons in the space plasmas rarely exchange their kinetic energies through collisional interactions but through plasma waves. This process is so-called “wave-particle interaction,” and it is indispensable for understanding space electromagnetic environments. WPIA (Wave-Particle Interaction Analyzer) is a new method of observing the wave-particle interaction. It calculates and sums up the inner product of measured electric field vectors and particle velocity vectors for each particle detection event, which provides us the amount of energy transfer between the waves and the particles. WPIA requires high relative time precision for the measurement of plasma waves and particles. Therefore a synchronous measurement of plasma waves and particles is necessary. We introduce a system that contains (1) a pulse is generated immediately after the event of particle detection inside the particle analyzer, (2) this triggered pulse is fed into the plasma wave receivers, and (3) timing information is assigned based on the internal clock of the plasma wave receiver. We are building this system by using ASIC (Application Specific Integrated Circuit) technology which reduces the necessary resources dramatically. The chip we developed consists of two stages. The first stage is a current-voltage conversion circuit. It picks up each current pulse and converts into voltage signals with enough amplitudes to drive the second stage. The second stage contains comparators and peak-hold circuits, where a threshold level can be set to reject a noise. The circuit we designed can generate the pulse within several nanoseconds from the particle detection event.
In this session, we show the details of the chip designed for the particle detection including experimental results.

Keywords: ASIC, WPIA, Wave-Particle Interaction, high-speed current detection circuits

P018

Characteristics of the Broadband Extremely Low Frequency waves through the Akebono observations with high time resolutions

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The ionized atmosphere, so-called plasma atmosphere moves out of the Earth into space in various regions. In particular, heavy ions such as oxygen ions flow out only from the polar atmosphere. The heavy ions need to gain enough kinetic energies to escape from the Earth’s gravity. Since the transverse energies of ions are converted into their parallel energies as they move to a higher altitude region in the mirror-shape magnetic field lines, transverse acceleration mechanisms are important in the relation to the atmospheric escape in the polar regions. The most plausible energy source which supplies energies to heavy ions is plasma waves. The BBELF or Broad-Band Extremely Low-Frequency waves show a good correlation of their spectral intensities with the existence of transversely accelerated ions. A lot of attempts have been made to reveal the wave modes and generation mechanisms of the BBLEF, but they are still unclear. The present paper focuses on the Akebono high time resolution data. The high time resolution data reveal the detailed spectral features of the BBELF and provide us with some clues in identifying its plasma wave mode and the related characteristics.

P019

Isolated electrostatic potential structures observed by the Arase satellite

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Some isolated potential structures are observed by Plasma Wave Experiment (PWE) onboard the Arase satellite. They are completely electrostatic. When they move in a relative velocity to the satellite, PWE can observe spatial potential variations as electric field waveforms in the time domain. One of the types of these waveforms is electrostatic solitary waves (ESW) that are discovered by the GEOTAIL spacecraft in the geomagnetic tail region in 1994. The propagation velocities of the isolated potential structures are not known. However, the Arase PWE has the function that is capable of identify the propagation velocities. The function called interferometry mode. This mode makes use of one set of the dipole antenna as two monopole antennas. Two monopole antennas observe waveforms individually, and the time lag observed between two antennas shows the propagation velocity. We analyze ESW through the two types of data observed dipole mode and interferometry mode.

Keywords: space plasma, isolated electrostatic potential structure, spatial potential, interferometry mode, propagation velocity

P020

Spatio-temporal distribution of the region where EMIC waves grow nonlinearly in the inner magnetosphere

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For generation and decay of the radiation belt electrons surrounding the earth, the interaction between electromagnetic waves and electrons is suggested to play an important role. The whistler-mode chorus waves are thought to accelerate electrons to intensify the radiation belt, whereas the electromagnetic ion cyclotron (EMIC) waves are thought to result in the decay of it. Recently, nonlinear growth of the EMIC waves accompanied with rising tone elements is suggested to scatter the relativistic electrons efficiently. The purpose of this study is to identify the region where the EMIC waves can grow nonlinearly in the inner magnetosphere. The global electric and magnetic fields obtained by global magnetohydrodynamic (MHD) simulation were given to the advection simulation that solves evolution of the particle distribution function of protons trapped in the inner magnetosphere. Fast solar wind accompanied with southward interplanetary magnetic field is imposed to the global MHD simulation. From the distribution function of the protons, we evaluated the region where the EMIC waves are excited nonlinearly.

Keywords: Radiation belt, electromagnetic ion cyclotron (EMIC) wave, magnetohydrodynamic (MHD) simulation, advection simulation

P021

Preparation and properties of anisotropic cellulose nanofiber aerogels based on directional freezing technology

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In recent years, in order to make aerogels widely used in many civilian fields, nanocellulose has been used as a raw material to prepare cellulose nanofiber aerogels with functionality. In this work, the effects of temperature, cold sources and freezing methods (directional freezing and conventional freezing) on the structure and properties of TEMPO oxidized nanocellulose aerogels were discussed. By comparison, it was found that anisotropic cellulose aerogels could be obtained by using -30 ℃ ethanol as a cold source with a simple self-made directional freezing device. The results showed that the aerogels exhibited a honeycomb porous structure in the transverse direction and a regular aligned directional channel in the longitudinal direction. It also provided some excellent characteristics, such as super absorbency (120 g/g) and good water stability. Under 50 % compression strain, the longitudinal stress can withstand 15.2 KPa, which was much higher than the transverse stress of 3.5 KPa. In the solvent transport experiment, because of the ordered structure in the longitudinal direction, the rapid directional solvent transport could be achieved, which was 2-3 times higher than another direction. Furthermore, the enhanced performances are expected to improve the added value and functionality. And the selective directional transmission of electricity, heat and magnetism can be expanded to meet the needs of different fields.

Keywords: Cellulose nanofibers, aerogels, directional freezing, anisotropy

P022

Synthesis and characterization of aminosilane grafted cellulose nanocrystal modified formaldehyde-free decorative paper and its CO_2 adsorption capacity

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In this work, we have obtained formaldehyde-free decorative paper with high CO_2 adsorption capacity. Cellulose nanocrystal (CNC) were prepared by hydrolyzing microcrystalline cellulose (MCC) with sulfuric acid. Then, The N-(2-aminoethyl) (3-amino-propyl) methyldimethoxysilane (AEAPMDS) was grafted onto CNC by liquid phase hydrothermal treatment, and the aqueous solution was substituted by tert-butanol to obtain aminated CNC (AEAPMDS-CNC). Finally, AEAPMDS-CNC was applied to formaldehyde-free decorative paper impregnated with water-based acrylic resin by spin-coating method. The effects of various parameters on the properties of synthetic materials were systematically studied, and the optimum reaction conditions were revealed. The surface bonding strength and wear resistance of modified formaldehyde-free decorative paper were tested. The experimental results showed that AEAPMDS grafted successfully without destroying the basic morphology of CNC. The formaldehyde-free decorative paper coated with AEAPMDS-CNC had high CO_2 adsorption capacity and exhibited good bonding and wear resistance. Therefore, laminating the prepared formaldehyde-free decorative paper onto indoor furniture can achieve the purpose of capturing indoor CO_2 and might have a highly potential use for the indoor decoration.

Keywords: Cellulose nanocrystal (CNC), Amine modifcation, Formaldehyde-free decorative paper, CO_2 adsorption capacity

P023

Cellulose derived carbon nanofiber based catalyst for organic contaminant degradation in water media

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Cellulose is an economic and abundant existed biomass material which is cheap and easily obtained. Through an electrospinning and pyrolysis process, the cellulose could be readily turned to carbon nanofiber, which is a potential alternative for the traditional petroleum derived carbonaceous materials. We recently used the cellulose derived carbon nanofiebrs (CCNFs) as the support to enhance the catalytic performance of some semiconductor catalysts recently, for the application of organic contaminants degradation in water media. Specifically, the CCNFs could both enhance the photocatalytic performance and catalytic activation performance of BiOBr and CoFe2O4, specifically. With the assistance of the CCNFs, the degradation speed of organic pollutant molecules such as RhB dye and dimethyl phthalate enhanced significantly.

Keywords: Carbon nanofiber, cellulose, pollutant degradation, photocatalysis, catalytic activation

P024

Fabrication and regulation of sensitive cellulose nanocrystal films

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The sensitive cellulose nanocrystals (CNCs) films were facilely fabricated with acid slurry ratio of 8:1, acid hydrolysis temperature of 45 °C (CNCs-1), acid slurry ratio of 8:1, acid hydrolysis temperature of 60 °C (CNCs-2), acid slurry ratio of 10:1, acid hydrolysis temperature of 45 °C (CNCs-3), respectively. The color of CNCs films were sensitive to humidity, this could be attributed to the humidity sensitivity of maximum reflection wavelength. The maximum reflection wavelength response range approached 153 nm, 63 nm, and 29 nm with ambient humidity increasing from 43% to 86% for CNCs-1, CNCs-2, and CNCs-3, respectively, which indicates the red-shift phenomenon of the CNCs films. The redshift phenomenon of CNCs films resulted from the formation of hydrogen bonding. Furthermore, the color response showed good stability under cyclic experiments. The acid-to-pulp ratio had a more obvious effect than hydrolysis temperature on maximum reflection wavelength of CNCs. These results suggest that the humidity sensitive range of CNCs films could be regulated by a simple adjustment to the acid-to-pulp ratio or hydrolysis temperature, which reveals the potential for CNCs iridescent film to act as a sensor in monitoring humidity.

Keywords: cellulose nanocrystal, chiral nematic, humidity, photonic films

P025

Preparation and characterization of reed straw-based nanocellulose

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In this paper, in order to achieve the efficient use of natural and renewable resources and make full use of the rich source, cheap and easy-to-access reed straw, they were made into high value-added nanocellulose by using a combination of chemical and physical methods. Characterized by Fourier transform infrared spectroscopy (FTIR), thermogravimetry(TG), transmission electron microscope(TEM), X-ray diffraction(XRD)and other methods, the differences between the homemade straw-based nanocellulose and the purchase of industrial production of cork-based nanocellulose in the performance of nanocellulose produced by different raw materials were explored. It was showed that NCC were arranged irregularly in the aqueous solution, and many were in amorphous state, some even appeared to be curled through TEM analysis. It was also learned that by XRD analysis homemade NCC and foreign-purchased NCC was cellulose II, and the crystallizability was slightly smaller than the purchase of nanocellulose. The XRD spectra were basically the same with little difference, which was consistent with the analysis results of FTIR, TG and DTG and other analysis. The final results indicated that the lab-made nano-crystalline cellulose had hardly any difference compared with the boughten nano-crystalline cellulose which was based on cork.

Keywords: Nanocellulose, reed straw, renewable, Crystallizability

P026

Study on adsorption-photocatalytic properties of cellulose nanocrystal supported ZnO nanocomposites

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Cellulose nanocrystal (CNC) supported nano-ZnO (CNC/ZnO) was prepared using CNC as a template with a procedure of precipitation method. With further carbonized under 550 ℃, carbonized CNC/ZnO nanocomposite (C-CNC/ZnO) was obtained. Morphology and properties of CNC/ZnO and C-CNC/ZnO nanocomposites were characterized by TEM, XRD, FT-IR, and UV-Vis DRS, respectively. Adsorption-photocatalytic properties were investigated by removing methylene blue (MB). The results show that: CNC acts as a supporting agent to anchor ZnO by electrostatic interaction. Nano-ZnO were arranged in short-rod shape and uniformly deposited on the surface of CNC and carbonized CNC. Introduction of CNC and carbonization have an important impact on the crystal structures and optical properties of nano-ZnO. The adsorption-photocatalytic property test shows that: the obtained CNC/ZnO composite has good adsorption performance with the MB removal rate of 58% under darkness condition for 60 min. And under the continuous irradiation of light for 60 min, its MB adsorption-photocatalytic removal rate is 88%. The obtained C-CNC/ZnO composite has the optimum removal efficiency to MB, corresponding to 42% MB adsorption removal rate with darkness condition, and 99% MB adsorption-photocatalytic removal rate after the light irradiation for 60 min at room temperature.

Keywords: ZnO, cellulose nanocrystal, biochar, adsorption, photocatalysis

P027

Green Preparation of Functionalized Cellulose Nanocrystal

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Explore a facile and environmental approach for preparing functionalized cellulose nanocrystal is significant for its wide applications but remains a huge challenge due to complex process and low yield. In this work, an environmentally benign approach for the manufacture of silane functionalized cellulose nanocrystals (*f*-CNCs) via one-pot ball milling was put forward. Through the synergy of mechanical and chemical actions, the produced *f*-CNCs exhibited a typical needle-like geometry with 390 nm in length and 24 nm in diameter. The DS of surface functionalization of MCC can reach up to 0.35 much higher than those in other reports, this green one-step approach gave cellulose nanocrystallation with 80% yield. This study opens a window for fabricating the environmentally friendly and large-scale functionalized NCC with controllable grafting ratio.

Keywords: cellulose nanocrystal, ball milling, functionalization, environmental

P028

Flame retardant-wood polyethylene composites: strain transfer and rheology

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A green hybrid flame retardant was prepared via incorporating cellulose nanocrystals (CNCs) into ammonium polyphosphate (APP) through ionic and hydrogen bonding, and enabled the immiscible APP to had a well dispersion in WPC. All WPC/APP-CNC had more obvious shear thinning behavior than that of WPC/APP, and the melting viscosity of WPC/APP-CNC increased with an increase of CNC content. Meanwhile, digital image correlation, combining with the tensile testing, demonstrated that the stress of WPC/APP-CNC exhibited well transfer with lower load differential gradient, and less strain concentrations than those of WPC/APP, particularly for WPC/APP-9wt%CNC which displayed highest load capacity and a synchronously promoted stress/strain transfer. Therefore, CNC acted as a dispersion and interface modifier, simultaneously promoting a perfect rheology behavior and mechanical properties of flame retardant-WPC.

Keywords: Cellulose nanocrystals, WPC, train transfer, Rheology, Digital image correlation

P029

Exploration of effect of delignification on the mesopore structure in poplar cell wall by Nitrogen absorption method

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As an important commodity wood material, poplar has porous structure, which is worthy of being investigated. Especially, the lignin concentration is closely related to the formation and change of pores. In this study, the distribution and changing pattern of mesopores in poplar samples were studied by N_2 adsorption method. It was found that delignification increased the N_2 adsorption amount and specific surface area of poplar. It also caused a large number of mesopores in the cell wall, mainly in the 2-10 nm pore size range, and decreased the average pore size. The whole delignification process can be roughly divided into three major phases, namely, the initial phase, the transitional phase and the stable phase, in which, the change process was not completely uniform. During the delignification, the size of poplar cell wall pores continued reducing, and finally a large number of uniform pores of about 2.1 nm was formed.

Keywords: BJH method, N_2 adsorption method, poplar, mesopore structure, progressive delignification

P030

Controlling the Distribution of Graphene in PLA for prepared Multi-functional PLA composites

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Polylactic acid (PLA) is a new biodegradable material, which is widely concerned due to its high mechanical strength and biodegradability. However, its inherent brittleness, low flame retardant and electrical insulation seriously limit its practical application. In this paper, the biological polyester functionalized graphene was prepared to endow PLA with high toughness has excellent flame retardant and antistatic properties. The resulting PLA composites were prepared by adding polyester functionalized graphene into the chloroform solution of polylactic acid/ poly(butylene succinate) and polylactic acid/poly propylene carbonate. By changing the surface activity of graphene, the distribution mechanism of thermodynamic regulation based on graphene elements was constructed, and its localization in the PLA composites could be regulated. The results showed that the addition of only 5% biodegradable polyester functionalized graphene could reduce the heat release rate and increase the electrical conductivity and increase the elongation at break This study provides a theoretical basis for preparing polylactic acid composites with high mechanical properties and multiple functions.

Keywords: Polylactic acid, Graphene, Toughness, Flame retardancy, Antistatic property

P031

Investigation of Surface modification and dispersibility of nano-Ag/TiO_2

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This paper mainly explores the enhancement of the dispersion of nano-Ag/TiO_2 in water by surface modification. Nano-Ag/TiO_2 was modified by anionic, cationic, non-polar surfactants and silane coupling agents. Through the stability, particle size, Zeta potential, the influence of surface modifier on dispersion performance was studied to select the best surface modifier. (1) Dispersion and stability of nano-Ag/TiO_2 can be improved by adding surfactant,after adding surfactant, the particle size of nano-Ag/TiO_2 showed single peak or double peak, and the distribution was more even. The average particle size was smaller than that of unadded dispersion. Among them, SHMP (Anionic surfactant sodium hexametaphosphate)has the best effect.With the increase of SHMP, the stability of the system increased. (2) The addition of silane coupling agent could affect the dispersibility and stability of nano-Ag/TiO_2, among which KH560 (gamma-glycidyl ether oxypropyl trimethoxylsilane) had the best effect. With the increase of KH560, the system stability increased.

Keywords: Nano-Ag/TiO_2, Surface modification, Dispersivity, Stability

P032

Self-assembly of a polyelectrolyte complex and its applications on flame retardancy of wood-polyethylene composites

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In this paper, a flame retardant was prepared with polyelectrolyte, and the flame retardant was added to HDPE to improve the flame retardancy and mechanical properties of wood-plastic composite. The polyelectrolyte complex (PEC), that is, the flame retardant was obtained by cellulose nanocrystalline (CNC), polyethyleneimine (PEI) and ammonium polyphosphate (APP). PEC retained the original shape of the rigid rod of the CNC, but the surface was rougher than the CNC, and the system was more stable. Further, PEC was applied to WPC, and the results showed that the LOI was 24.4%, which was improved compared with 23.9% of WPC/APP. The peak HRR, THR and TSR of WPC with PEC decreased by 25.2%, 6.8% and 27.8%, respectively, compared with WPC/APP. The WPC with the PEC could release a large amount of non-combustible gas in advance, forming a continuous dense carbon layer, and adsorbing the smoke generated during the combustion process. In addition, PEI has good dispersibility and can improve the interfacial compatibility between the PEC and WPC. The strength and toughness of the WPC treated by flame retardant were obviously improved.

Keywords: Wood-plastic composites, polyelectrolyte complex, flame retardancy, thermal stabilities, mechanical properties

P033

The Research for Mechanical Performance of Modified Starch/Cellulose with Silica by Adsorption Method Filled into SBR Rubber Latex

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Styrene-butadiene Rubber (SBR) Latex composites, incorporated with cellulose/starch-silica hybrids synthesized by gel-adsorption method, were filled into rubber by the latex compounding method. The structure morphology, mechanical properties, and thermodynamic properties of gel-silica hybrids were characterized. The states of hybrids which used as fillers were also characterized by SEM. As the fillers ratio increased, the difference for storage modulus of samples had been morphology by rubber process analyzer (RPA). Then, as more fillers ratio was filled into the matrix, the best tensile strength result, and the largest modulus value were also proved by UTM and RPA. As for thermal stability, increase in the ratio of fillers led to higher initial decomposition temperature, which was also proved by TGA. The swelling ratio of samples has also been characterized. And the oil& water resistance behavior was also proved by aging chamber. From the results of all the tests, cellulose-silica hybrid showed the best results as a filler, and the best filling ratio of this hybrid is about 10 phr, which has the best storage modulus and great tensile strength.

Keywords: Cellulose, Starch, Styrene-Butadiene rubber, Gel, Oil resistance

P034

Research and preparation of light driven and morphology regulatable shape-memory polyurethane materials based on host-guest

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After the light-induced shape memory material absorbs light energy, there are some physical and chemical changes will occur inside or between molecules, which resulting in a change in shape size. It enables non-contact, instantaneous, and accurate control over remote control. In this experiment, β-cyclodextrin and azobenzene were used to construct the host-guest supramolecular system, and waterborne polyurethane was used as the matrix. The morphology of the polyurethane was controlled by solution casting and freezing casting. A dense polyurethane film was prepared by solution casting. With the addition of β-cyclodextrin and azobenzene, the Young's modulus of the polyurethane film increased from 229 MPa to 599 MPa, and the tensile strength increased from 7 MPa to 13 MPa. The film was irradiated with ultraviolet light having a wavelength of 365 nm, and the light-driven shape recovery function was realized by the change of cis-trans isomerization of azobenzene. The freezing casting method allows the ice crystals to be directionally solidified, and a polyurethane having a highly porous morphology is prepared. This unique topography makes the polyurethane composite material flexible. The polyurethane has a compression ratio of 50% and a recovery rate of 95 % when β-cyclodextrin and azobenzene are added. The study expands the range of applications for polyurethane, it also provides a theoretical basis for the study of next-generation elastic sensors and optical drive electronics.

Keywords: host-guest, light-driven, freezing casting, polyurethane

P035

Preparation and application of cellulose based ZnO quantum dots composite functional materials

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A kind of zinc oxide quantum dots/cellulose bio-based composite functional material has been developed. Its fracture strength can reach 80 MPa, and the thermal decomposition temperature can be increased by 16 degrees Celsius. After surface modification of zinc oxide quantum dots with polymethyl methacrylate (PMMA) and cellulose, the elongation at break increased by 46%. The yellow dots and green fluorescence (510nm and 480nm) quantum dots which could be stable for 30 days in aqueous phase, were obtained by sol-gel method. By optimizing the traditional low temperature alkali/urea process, the solubility of inactivated cellulose was increased by 20%, and the strength did not change significantly. In the process of cellulose dissolution, zinc oxide quantum dots/cellulose bio-based composite functional film with anti-counterfeiting function was prepared by adding quantum dots into cellulose solution.

Keywords: cellulose, zinc oxide quantum dots (ZnO QDs), sol-gel, alkali/urea

P036

Preparation and application of a kind of bio based composite material with double anti-counterfeiting function

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In this article, we report a kind of rare earth core-shell nanoparticles prepared by thermal decomposition with an average scale of 5-15 nm. Through the introduction of two-layer shell, the concentration quenching of rare earth up conversion is reduced, and the efficiency is increased by 28%. The raw cotton pulp and the rare earth nanoparticles were dissolved in room temperature ionic liquid and regenerated in water bath to prepare the bio based composite functional material with double anti-counterfeiting functions of up conversion and down conversion. Its tensile strength was more than 120MPa. Under the excitation of 980nm near-infrared laser, there are four obvious emission peaks, and under the excitation of 360nm ultraviolet, there are strong emission peaks at 430nm. Two excitation modes, up conversion and quantum cutting, are clearly demonstrated. Therefore, these two different ways of excitation correspond to different anti-counterfeiting methods.

Keywords: Upconversion, quantum cutting, core-shell, Double anti-counterfeiting, cellulose

P037

Physical and Chemical Properties of Rice Seedling Substrate Mats made of Rice Straw without Using Plastic Trays

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The traditional materials of rice seedling trays for rice transplanting are polyvinyl chloride, polyethylene and polypropylene. In generally, these plastic trays will be recycled or discarded after rice transplanting. In China, the destruction of plastic trays per year accounts for 20% of total use which leads to heavy plastic pollution. In this study, the rice straw will be used as raw materials to prepare seedlings substrate mats in order to replace the traditional plastic trays. These mats were prepared by biological decomposition, fiber modification, vacuum molding and drying process. The results showed that the substrate mats not only provided an appropriate carrier like trays for rice seeds growing, but also offered rich nutrients like traditional substrate for rice seeds growing. The strength of substrate mats and root twister force after rice growing in 15 days were remarkably great. The water-retaining properties of substrate mats were also better than the traditional substrate. Our work demonstrates the possibility of using the seedling substrate mats to cultivate rice seedlings of high quality, suggesting a new way to replace traditional rice seedling technology.

Keywords: Seedling, Rice Straw, decomposition, substrate

P038

Nanocellulose as Multifunctional Additives in Bentonite-Water-based Drilling Fluids

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The approaching era of sustainable development and rapid increase in global energy demand necessitate high-performance drilling fluids with sustainability, advanced rheology, superior filtration performance, outstanding thermo- and salt-tolerance, and stimuli responsiveness to make the exploration and production of oil and gas more safe, efficient, productive and environmentally friendly. Herein, advanced water-based drilling fluids (WDFs) composed of bentonite (BT) and biomass-derived nanocellulose are formulated by taking advantages of gelling and waterproofing capacity of nanoplatelet-like BT and tunable surface chemistry of nanocellulose. Nanocellulose acted as rheological and filtration additives in BT-WDFs, and their morphology and surface characteristics played critical roles. Nanocellulose can be further functionalized through immobilizing of magnetic nanoparticles, and grafting of thermo-responsive and salt-resistant polymers, endowing magnetic responsiveness, thermo-thickening behavior and superior salt tolerance to nanocellulose suspensions as well as to nanocellulose/BT-WDFs. This work demonstrates that nanocellulose can be used as sustainable, smart, and multifunctional agents in water-based nanofluid formulations through rational dimension, surface chemistry and functionalization design, paving the way for their widespread applications in harsh, complex formation excavation.

Keywords: Nanocellulose, Drilling fluid, Rheology, Filtration, Functionalization

P039

Novel Fluorescence Probe of Cellulose-Based Nanocomposites for Detection of Mn^{2+} with Simpleness, Rapidity and High Sensitivity

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The concentration of Mn^{2+} maintained at the physiological level is indispensable, however, excessive manganese can accumulate in the brain to damage the nervous system, which may give rise to Alzheimer's and Parkinson's diseases. Therefore, U.S. Environmental Protection Agency (EPA), the World Hygiene Organization and European Union (EU) limit the maximum concentration of manganese in drinking water, that is 0.3mg/L, 0.4mg/L and 50 μg/L, repectively.
A novel, simple, rapid and sensitive fluorescence probe, that is Carboxymethyl cellulose (CMC)/Tb(III) with green fluorescence, for detecting Mn^{2+} in aqueous solution during pH=4 -10.was proposed in this work. The probe's synthesis had benefits of mild reaction condition, organic solvent-free and facile operation. A linear relationship between the fluorescence intensity of CMC/Tb(III) at 544nm with 0.046μM detection limitation and the concentration of Mn^{2+} in the range of 0.1-100μM was obtained. The probe was also used to detected Mn^{2+} in tap water and the recoveries were between 97.10% and 101.61%, and the relative standard deviations (RSD, n=5) of all samples were less than 2.04%. The results by UV absorption spectrum and fluorescence quenching suggested that there might be a dynamic quenching occurred to the fluorescence of CMC/Tb(III) probe when Mn^{2+} was involved.

Keywords: Cellulose-based nanocomposite, fluorescence detection, sensitivity

P040

Synthesis of magnetic wood, and their magnetic and electromagnetic wave absorption properties

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Based on the good characteristics of ferric irons, such as smaller size and better permeability in wood than those of nanoparticles, the pretreated wood was impregnated in the mixed solution of Fe^{3+} and Fe^{2+}, and followed by being impregnated in ammonia solution. Fe_3O_4 nanoparticles were prepared by in-situ co-precipitation method in the wood, and magnetic wood (Fe_3O_4/wood) was synthesized. X-ray diffraction (XRD), scanning electron microscope (SEM), energy dispersive spectrometer (EDS), vibrating sample magnetometer (VSM) and the network vector analyzer were used to investigate the composition, structure, magnetic and electromagnetic wave absorption properties of the synthesized samples. The concentration ratio of Fe^{3+} and Fe^{2+} in the impregnating solution was 2:1, the mass ratio of ammonia was 25%. The magnetic coercivities of the different parts (center, edge and corner) of the magnetic wood were 137.6, 28.15 Oe and 10.11 Oe, respectively, and their absorption capacities for electromagnetic wave at 5.0 GHz bands with the thickness of 3 mm were -0.63, -3.93 dB and -17.12 dB, respectively. These results indicated that the magnetic wood was successfully synthesized via in-situ co-precipitation and gradually dipping method. At the same time, the content and distribution of magnetic particles increased gradually and became more uniform from center to corner. The corner part of obtained magnetic wood was of good magnetic and electromagnetic wave absorption properties. The electromagnetic wave absorption capacities of magnetic wood increased gradually with the thickness increasement. The corner part of the magnetic wood with the thickness of 3 mm was suitable to be the informal absorbing materials for electromagnetic wave at 5.0 GHz considering the technical and economic requirements.

Keywords: magnetic wood, electromagnetic wave absorber, in-situ, co-precipitation

P041

Study on the preparation and properties of magnetic Reconstituted Bamboo

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Reconstituted bamboo is a bamboo-based fiber composite material, which is made up of bamboo bundles and bonded by hot /cold pressing along the texture direction. Because of its good texture, color and physical and mechanical properties, reconstituted bamboo has been widely used in indoor floor, furniture and decoration materials. In recent years, with the breakthroughs in the manufacturing technology of reconstituted bamboo in China, the demand for outdoor Reconstituted Bamboo is increasing, multifunctional bamboo based composite materials have attracted the research interest of some scholars, such as magnetic recombination bamboo. The systematic research on magnetic reconstituted bamboo has a great promoting effect on expanding the application field of reconstituted bamboo. It can also provide a basic theoretical basis for the formulation of standards and product development of outdoor reconstituted bamboo. It is of great significance to enhance the overall competitiveness of China's Reconstituted Bamboo industry, promote outdoor reconstituted bamboo products and increase its added value.

The magnetic reconstituted bamboo not only does not damage the basic properties of reconstituted bamboo, but also gives excellent electromagnetic wave absorption properties. This makes it have a good application prospect, for example, when it is used in places with large electromagnetic radiation, it can effectively protect human health. In this paper, we discussed the feasibility of the preparation of magnetic reconstituted bamboo.

Keywords: Reconstituted bamboo, Magnetic, Heat-treat, Impregnation method, Fe_3O_4 Magnetic Nano-particles

P042

Advance in Anti-mildew Research of Bamboo

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With the wide application of wood products, wood resources in recent years show a serious shortage of supply. Bamboo has the advantages of short production cycle and high yield, which is considered as one of the ideal substitutes for wood resources. It has been widely used in furniture, architecture, handicrafts and other fields. However, natural bamboo is rich in starch, protein, sugar and other substances. It is easy to be moulded by a variety of molds in a humid environment, which affects the use value of bamboo products and limits the use of bamboo products. More and more attention has been paid to the protection of bamboo. These methods include organic and inorganic impregnation, vitrification and high temperature heat treatment. In this paper, the research progress of bamboo mildew prevention at home and abroad in recent years is described in detail from the internal and external factors of bamboo mildew, common preservatives and new preservatives of bamboo, the methods of anti mildew treatment and anti mildew treatment process, and the future development direction in the aspects of safety, efficacy, technology and technology of anti mildew agent is prospected.

Keywords: Bamboo, Mouldproof, Research progress

P043

Preparation and properties of Quercus variabilis shell based carbon quantum dots / chitosan / polyvinyl alcohol composite films

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In order to make the agricultural and forestry waste - quercus emboli - can be used with high added value, with quercus emboli as the carbon source, the experiment was designed by orthogonal experiment method, and nine kinds of carbon quantum dots under different conditions were prepared by one-pot hydrothermal method.The prepared carbon quantum dots (CQDs) were added into the mixed solution of polyvinyl alcohol (PVA) and chitosan (CS) as additives, and the CQDs/CS/PVA composite film was obtained by ultrasonic method.The particle size of the carbon quantum dot was analyzed by hr-tem, the quantum yield, fluorescence spectrum and absorption spectrum were measured by fluorescence photometer and ultraviolet spectrophotometer, and the emission intensity of different carbon quantum dots under the same excitation and the emission intensity of the same carbon quantum dot under the same excitation were investigated.The CQDs/CS/PVA composite film was characterized by three kinds of instruments such as ultraviolet analyzer, ultraviolet spectrophotometer, fluorescence spectrometer, universal mechanical experiment machine, etc., to explore the fluorescence intensity, light transmittance and mechanical tensile properties of CQDs/CS/PVA composite film.Experimental results show that the optical properties of carbon quantum dots can be used to develop novel films with different uv blocking properties.Compared with the traditional uv barrier film packaging, it has been widely used in food and medicine, but the film cannot meet these diverse needs.As a new type of carbon emission material, CQDs has excellent uv blocking performance due to its photoluminescence and broadband absorption characteristics related to excitation wavelength.This time, CQDs was added to the mixed solution of polyvinyl alcohol (PVA) and chitosan (CS) to explore the uv barrier of the film produced.The final experiment shows that adding CQDs to PVA film can indeed change the uv barrier of the film, which is also the main significance of this experiment.

Keywords: Quercus quercus carbon-based quantum dots, Composite materials, Optical properties, Ultraviolet barrier

P044

Sustainable, Ultralight and Superhydrophobic Cellulose Nanofiber/Poly(vinyl alcohol) /Montmorillonite Aerogels as Recyclable Absorbents for Oil/Water Separation

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In recent years, due to the frequent occurrence of offshore oil spill accidents, it has become an urgent problem to be solved which how to deal with offshore oil spill quickly and effectively. As adsorption materials, the aerogel prepared by nanocellulose and polyvinyl alcohol has the characteristics of large specific surface area, high porosity, sustainably and environmental friendly, and has been widely used in the adsorption field. Montmorillonite, as a traditional silicate clay, plays a unique role in flame retardant and adsorption due to its unique lamellar structure, large specific surface area and adsorption performance. In this study, a simple, safe and green method which heating, dissolving and freeze-drying to prepare cellulose nanofiber(CNF)/polyvinyl alcohol(PVA)/montmorillonite(MMT) composite aerogel, and modified by chemical vapor deposition. The aerogel with low density (21.52mg/cm^{-3}), superior porosity(≧98%) and super hydrophobicity (water contact angle 140 °). The adsorption capacity is 35 times of the initial weight of aerogel, and it could be reused for 20 times without significant changes in adsorption capacity. Our work helps in the recovery of oil / organic solvents and the development of sustainable and efficient oil Absorbents.

Keywords: Cellulose nanofiber, MTM, aerogel, Oil adsorption, Recyclability

P045

Nanocellulose reinforced graphene/polypyrrole as an efficient counter electrode for fiber-shaped dye-sensitized solar cells

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Fiber-shaped dye-sensitized solar cells have become the promising materials in the field of portable photovoltaic devices due to their low cost, remarkable flexibility, wide material source, ever-increasing energy conversion efficiency, simple fabrication process and large-scale weaving. In this paper, nanocellulose reinforced graphene fibers with controlled polypyrrole weight percentages were synthesized via simple wet-spinning method and finally wound on a titanium dioxide nanotube to produce a fiber-shaped dye-sensitized solar cell. The excellent tensile strength and electrocatalytic activity of the microfiber guarantee the flexibility and photoelectric conversion efficiency of dye-sensitized solar cells as a counter electrode. The existing strategy combines the available wet-spinning technology and the well-designed structure for the fabrication of high-performance fiber-shaped photovoltaic materials, providing a good reference for the development and application of flexible, portable, wearable energy conversion devices.

Keywords: Nanocellulose, Graphene, Polypyrrole, Fiber-shaped dye-sensitized solar cells, counter electrode

P046

Interface reinforcement of pulp fiber based ABS composite with hydrogen bonding initiated interlinked structure via alkaline oxidation and tert-butyl grafting on cellulose

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Interface optimization in preparing natural fiber based biocomposite becomes a key factor determining overall properties especially mechanical performance. The solution for upgrading interfacial adhesion stemmed from polar fiber and nonpolar resin remains unclear. Here, a kind of pulp fiber/ABS composite with content ratio of 1:1 was fabricated by functionalizing cellulose fiber to coordinate interaction between fiber and ABS. With addition of 5wt% PAM there existed an interlinked three-element structure in composite. Three types of treatment to cellulose fiber including alkali immersion, pivaloyl chloride grafting for 10 hours and 20 hours were conducted. Pulp fiber treated with alkali for one hour followed by pivaloyl chloride reaction for ten hours was proved effective for interfacial adhesion. XPS analysis reveals 21.94% of carbonyl and 12.07% of ester function in this fiber which correspond to oxidation and grafting. For its composite SEM picture displays most of cellulose fiber are rooted in ABS and evident traces of tearing or fracture can be observed after tension test. DMA test indicates this modified pulp fiber/ABS composite exhibits great compatibility because of combined loss modulus peak ranging from 80℃ to 100℃. Moreover, the well miscible composite has tensile strength of 58.12 MPa and elastic modulus of 2515.05 MPa. They increase by nearly 50% and 60% from those of pure ABS respectively.

Keywords: Biomass ABS, Modification, Interfacial adhesion, Compatibility, Interlinked structure

P047

Nanocellulose reinforced hierarchical nanocomposites for high thermal performing flexible and transparent electrodes

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Transparent plastics coated with a nano-network of metal nanowires or carbon nanomaterials are promising future electrodes for large-area, lightweight, and flexible optoelectronic devices. However, plastics are generally thermal dimensionally instable, meaning that they expand and shrink in response to temperature change. This behavior may severe the ultrathin nano-network of the conducting nanomaterials, resulting in reduced performance of the electrodes and the optoelectronic devices fabricated on them. In this study, an incredibly thermal dimensionally stable (3.26−4.68 ppm K^{-1}) transparent and flexible plastic substrate was fabricated that resulted in high thermal performance of the silver nanowire (AgNW) electrode and a smart optoelectronic device. The high thermal dimensional stability was achieved through the generation of a hierarchical network of cellulose nanorods in the acrylic plastic via an emulsification process. The improved nanocomposite electrode exhibited good electro-optical performance (12.4−15.6 Ω sq^{-1} vs. 84%), high flexibility, good mechanics even at 150 °C, and the capability to withstand repeated extreme heating and cooling at 150 °C and −196 °C, respectively. Therefore, it is expected that the developed high-performance electrode will find potential application in advanced electronic devices, which can be used in extreme thermal conditions.

Keywords: Cellulose nanorods, transparent conductive electrodes, Pickering emulsion, nanocomposites, thermal stability

P048

Study on the biological modification of straw fibers influenced by fermentation days for pursuing quality of rice seedling

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Utilization of crop straw fibers in soilless substrates could make full use of discarded straw resources. In our previous study, we have demonstrated that crop straw fibers can be used to prepare rice seedling substrate mats with biological and mechanical methods. However, the quality of rice seedling was found to be connected with the days of biological fermentation. In this study, different compositing days 0 d, 5 d, 10 d, 15 d were selected to prepare modified rice straw fibers as our raw materials. We measured some key element indicators for rice seedling growing like total nitrogen (TN), total phosphorus (TP) to discuss the changing regulation of organic matter in the composting straw. Results showed that the content of different elements such as nitrogen, phosphorus and potassium had a significantly linear growth along with the increase of rotten days, while the pH slightly reduced with the increase of composting day and the electronic commerce had opposite trend.

Keywords: rice seedling substrate, discarded straw resources, biological fermentation

P049

Multifunctional Wet-Spun Filaments Through Robust Nanocellulose Networks Wrapping to Single-Walled Carbon Nanotubes

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Cellulose nanofibrils (CNFs) and single-walled carbon nanotubes (SWNTs) hold potential for fabricating multifunctional composites with remarkable performance. However, it is technically tough to fabricate materials by CNFs and SWNTs with their intact properties, mainly due to weakly synergistic interaction. Hence, constructing sturdy interfaces and sequential connectivity not only can enhance mechanical strength but also are capable of improving the electrical conductivity. In that way, we report CNF/SWNT filaments composed of axially oriented building blocks with robust CNF networks wrapping to SWNTs. The composite filaments obtained through the combination of three-mill-roll and wet-spinning strategy display high strength up to ~ 472.17 MPa and a strain of ~ 11.77 %, exceeding most results of CNF/SWNT composites investigated in previous literature. Meanwhile, the filaments possess electrical conductivity of ~ 86.43 S/cm, which is also positively dependent on temperature changes. The multifunctional filaments are further manufactured as a strain sensor to measure mass variation and surveil muscular movements, leading to becoming optimistic incentives in the fields of portable gauge measuring and wearable bioelectronic therapeutics.

Keywords: CNF networks, wrapping, three-roll-mill strategy, multifunctional filaments, strain sensor

P050

Poplar-Based Solar Steam Generation Device

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The shortage of fresh water is becoming a pressing challenge worldwide. Interfacial solar steam transformation fully absorbs solar energy and converts energy to the gas-liquid interface through the design of micro-nano structural materials and effective optical and thermal regulation. As a result, the efficiency of light-steam energy transformation is effectively improved. Therefore, it is considered as a promising efficient solar energy photothermal transformation approach. In this work, we report that poplar can be utilized as an ideal solar absorber after carbonization with ultrahigh solar absorbance (~90%), and great hydrophilicity, the carbonized poplar can localize the solar heating at the evaporation surface and enable a solar-thermal efficiency of ~80% under a solar intensity of 1 $kW \cdot m^{-2}$, and it thus represents a renewable , low-cost, and robust material for solar steam applications.

Keywords: solar energy, wood, great hydrophilicity, photothermal conversion, solar steam generation

P051

Preparation and Characterization of Cottonseed Meal Adhesive for Wood-based Panels

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Environmental-friendly green adhesives have become a research focus in the wood-based panel industry. In this study, cottonseed meal was used as the adhesive base material. The cottonseed meal was pretreated and modified with urea and zinc oxide to prepare cotton protein adhesives. Wood panels were made and tested. The results showed that the bonding strength of the panels could meet the requirements of national standard (GB/T 17657-2013). Fourier Transform Infrared Spectrometer (FTIR) test results confirmed the reaction between zinc oxide and cotton protein to form a stable ring structure. Thermal gravity analysis (TGA) results showed that the modified cotton protein adhesive had a better thermal stability. The optimum modification condition was: (1) the concentration of urea was 2mol/L, (2) the addition of zinc oxide was 4%, and (3) the reaction temperature was 70℃.

P052

Preparation and Properties of Activated Carbon/Ultra High Molecular Weight Polyethylene Composites

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As a derivative of straw resources, biomass activated carbon (AC) continues the renewable, green and high added value of biomass materials, and reduces the emission of carbon in the atmosphere, which is of great significance for environmental protection. In this paper, biomass activated carbon carbon powder was used as a filler to prepare a new carbon-plastic composite material with ultra-high molecular weight polyethylene. On the basis of carbon-based binary composite materials, EMA-GMA toughening agent was added to prepare high-strength and high-tough ternary composite materials, and the mechanical properties, microscopic morphology and thermodynamic properties of the materials were tested. The activated carbon has good chemical stability, developed pore structure and large specific surface area. When the amount of composite added is 65%, the tensile strength changes from 22.93Mpa to 97.65Mpa, which is increased by 325.86%. The elastic modulus changed from 183.06Mpa to 1959.63Mpa, an increase of 970.48%. Even when the activated carbon carbon content reaches 70%, the tensile strength can reach 70.59 MPa. This topic will further clarify the principle of strengthening the mechanical properties of composite materials, and study the interface bonding mechanism of composite materials from the microscopic scale.

Keywords: Biomass, Composites, Mechanical properties, Interface bonding, Thermodynamics

P053

A Review of National and International Studies on Reconstituted Bamboo Lumber Anti-photodegradation Technology

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With the shortage of forest resources in the world, as a big country of bamboo resources,using bamboo instead of wood is the best way to solve the current wood supply gap in China.Reconstituted bamboo is a new type of reconstituted bamboo material studied in the 1990s. It has excellent performance and over 90% utilization rate. It is a new product with great development potential. However, when it is used outdoors, it is obviously affected by environmental factors such as light and water. Its service life is reduced and its physical and chemical properties are reduced. Aiming at the defects of outdoor application of reconstituted bamboo, this paper analyzes the influence of uv on the properties of reconstituted bamboo in heat treatment. In addition, the paper systematically and fully reviewed the reconstituted anti-photodegradation treatment in terms of finishing processing and chemical modification.

Keywords: Reconstituted bamboo, Anti-photodegradation, Research progress, heat treatment

P054

Research on 3D printing of magnetic biochar materials

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With the development and progress of science, 3D printing technology has also become the forefront of materials research. On the basis of composite material science, we applied 3D printing technology to material experiments. We use the knowledge of 3D modeling and materials science to better understand printing technology. Here we mainly carbonize the magnetic foams into the magnetic biochar composite material through high temperature, then grind it into powder and mix with dichloromethane to make raw materials for 3D printing. Different from graphene, we need explore the 3D printing method by setting temperature, air pressure, printing speed and other parameters to get the required size of the block. All samples are printed on a smooth PTFE coated substrate. The x-y velocity varies from 10 mm / s to 45 mm / s depending on the structure being manufactured. The results show that, unlike the graphene printing experiment, magnetic biochar needs to undergo high temperature carbonization at 1000℃. And the mass fraction of carbon is related to temperature. The temperature needed for printing increases with the increase of the amount of biochar. Compared with the mechanical pressed block, the 3D printed block has excellent electromagnetic wave performance.

Keywords: 3D printing, magnetic biochar, magnetic foam

P055

Macropores and Robust Bamboo Charcoal Enables Efficient Interfacial Solar Steam Generation

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Given the global challenges of energy crisis and fresh water shortage, interfacial solar steam generation (ISSG) has received tremendous attention for its potential in utilizing solar energy and non-potable water, and various applications such as purification, sterilization and photocatalytic. So far, mainly focused on artificial structures that are designed and fabricated to improve energy conversion efficiencies by enhancing solar absorption, heat localization, water supply, and vapor transportation. As one of the most abundant non-wood cellulose resources in the tropics and sub-tropical areas, we have designed a one-step bamboo strategy to maintain hydrophilicity, increased solar absorption (94.12%) and reduced thermal conductivity (0.552 W m^{-1} K^{-1}) in situ for the fabrication of efficient ISSG. As a hierarchical cellular material, the bamboo ISSG with a steam generation efficiency of 94.4% and an evaporation rate as high as 1.522 kg m^{-2} h^{-1} at 1 sun (100mW cm^{-2}) with long term stability. These findings not only revealed the hidden talent of bamboo as low-cost materials ($1.8 per kg) for ISSG but also provided inspiration for the future development of high performance solar thermal conversion devices.

Keywords: interfacial solar steam generation, bamboo charcoal, hierarchical cellular, energy conversion

P056

Two continuous methods to fabricate micro fibrillated cellulose reinforced HDPE composites

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Micro fibrillated cellulose (MFC) reinforced high density polyethylene (HDPE) composites was fabricated by two continuous methods that are realizable to industrial production. One method was relative to the mixing in MFC water suspension, and the other corresponded to the cationic polyacrylamide (CPAM) reinforcing agent method which was mixed with dry MFC. The flexural strength (MOR) and flexural modulus (MOE) of MFC/HDPE composites with the CPAM reinforcing agent method were much higher than those of suspension mixing method. The MOR was increased from 27.83 MPa for neat HDPE, to 79.56 MPa which was 32 % higher than suspension hybrid method (60.22 MPa). The MOE also increased to 3.49 GPa which was 39.40 % higher than suspension hybrid method (2.48 GPa), and 324.50 % higher than neat HDPE (0.82 GPa). The addition of cellulose reduced the coefficient of thermal expansion of composites by up to 80 %. The result shows that the addition of MFC can dramatically increase the mechanical property of HDPE. The CPAM reinforcing agent method shows better mechanical strength, while suspension method shows lower cost and continuous operation.

Keywords: Micro fibrillated cellulose, High density polyethylene, Cationic polyacrylamide, Reinforce

P057

Dual-triggered CMC/Dopamine/Cystamine Hydrogels Driven by Dynamic Metal-Ligand and Redox for Self-Healing and Drug Release

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Expanding the useful lifespan of materials is becoming highly desirable, and self-healing and stimuli-responsive materials may become valuable commodities. Dual-triggered dopamine (DA)/cystamine (CYS) hybrid carboxymethyl cellulose (CMC)-based hydrogels are synthesized. The system introduces a dual stimuli-responsive hydrogel containing CMC chains modified with electron donor dopamine sites and disulfide bonds. In the presence of DA and CYS, a stiff hydrogel consists of CMC chains is formed, cooperatively stabilized and cross-linked by dynamically restructuring DA/metal-ligand interactions and by CYS. The cyclic and reversible formation and dissociation of the supramolecular donor-acceptor interactions, through dynamic metal–ligand coordination with DA, or via reduction and subsequent oxidation of the CYS sites, leads to hydrogels of self-healing and switchable stiffness. Based on this, a facile and versatile method is suggested for directly integrating drugs into CMC-based hydrogels as a surface-mediated drug delivery platform, which is favorable for the long-term sustained release of the drug. The dynamic properties of thess dual-triggered hydrogels provide great potential for drug delivery in a wide variety of biomedical applications.

Keywords: Dopamine, Redox, self-healing, drug release

P058

Preparation of Wood-based Carbon Dots and Its Application in Anti-counterfeiting Ink

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More and more attention has been paid to the high value utilization of wood waste. Wood waste is rich in C, H and O elements, which is very conducive to the preparation of carbon dots (CDs). Due to the advantage of wide raw carbon sources, green preparation and stable fluorescence performance, CDs can be used as substitutes for fluorescent pigments in fluorescent ink. Herein, the CDs with blue fluorescent emission is obtained by a hydrothermal carbonization from wood waste. The fluorescent ink consists of the fluorescent pigment (the prepared CDs), binder (a mixture of ethanol, glycol and glycerol), stabilizer (the carboxymethylcellulose sodium), and surfactant (the polyvinylpyrrolidone solution) via solution blending treatment. By means of the TEM, PL and UV-vis analytical techniques, it is shown that the prepared CDs for fluorescent pigment with an average particle size of 2.5 nm emits blue fluorescence under the excitation wavelength of 335 nm. And the fluorescence quantum yield of the CDs is 3.79%. It is observed that the fluorescent ink is transparent under white light, while it is blue under ultraviolet irradiation (365 nm). In summary, we synthesize the CDs from wood waste and explore its application in fluorescent ink for anti-counterfeiting.

Keywords: carbon dots, wood waste, fluorescent ink, anti-counterfeiting

P059

Metal-Organic Framework Interwoven by PANI Decorated Carbon Fiber Paper Electrode for Supercapacitors

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Metal-organic framework (MOF) has been identified as promising electrode material for supercapacitors. However, its application in supercapacitors is largely hindered by its poor electrical conductivity and capacity. This study synthesized carbon fiber paper (CFP)/ MOF/ Polyaniline (PANI) electrode for supercapacitors. CFP was pretreated with H_2SO_4 to improve its hydrophilicity, MOF was synthesized by one-step solvent thermal method, and PANI was interwoven with MOF by electrodeposition. CFP provides good conductivity for the electrode. Its low capacity can be tackled by synthesized with MOF and PANI. This experiment takes advantage of the porous nanostructures and high specific surface area of MOF. The poor intrinsic conductivity and low capacity of MOF is improved by interweaving with PANI. As a result, the mass loading of MOF was ≈2mg/1×2cm^2, and the mass loading of PANI was ≈1mg/1×2cm^2. The composite electrode delivered a high capacitance of 56mF/cm^2 at 1mA/cm^2. In a word, this feasible method should be appropriate for the fabrication of electrode for high performance supercapacitors.

Keywords: Carbon fiber paper, Metal-organic framework, Polyaniline, Electrode, Supercapacitor

P060

CoOOH nanosheets array on bacterial cellulose: A stable and efficient electrocatalyst for oxidation evolution reaction

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Using bacterial cellulose as the substrate, adsorbing Co^{2+} as a precursor (Co^{2+}/BC), fully freeze-drying and high-temperature carbonization to obtain CoC/BCCF, and further converting the obtained CoC/BCCF into CoS_2/BCCF using sulfur vulcanization. Using CoS_2/BCCF as a working electrode, electrolyzed 1.0 M KOH to obtain CoOOH/BCCF. We found that CoOOH/BCCF has similar catalytic activity to CoS_2/BCCF for OER (Oxidation evolution reaction), only need 1.50 V to rearch the current density of 10mA·cm^{-2}. the acquired CoOOH/BCCF exhibits excellent application stability at 1.0 M KOH.

Keywords: bacterial cellulose, high-temperature carbonization, sulfur vulcanization, working electrode, catalytic activity, Oxidation evolution reaction

P061

A strong wood-based hydrogel with superflexibility

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Wood is a kind of porous, layered, anisotropic heterogeneous natural polymer composite material with high strength and modulus. Here a facial is reported method to fabricate a strong wood-based hydrogel with a naturally aligned skeleton. The wood fiber skeleton was prepared by delignification and then composited with polyacrylamide (PAM) by chemical polymerization. During these processes, the natural wood skeleton is well preserved, and sufficient tensile stress is built along the longitudinal direction of wood cellulose, leading to a highly anisotropic structure in the prepared PAM/delignified wood hydrogels. Through applying a novel alkali treatment on the delignified wood, the super-flexible PAM/alkali-treated delignified wood hydrogels was prepared. The results showed that PAM was filled in the pores of the wood fiber skeleton and the interfacial compatibility between PAM and wood fiber skeleton is good. In addition, the light transmittance of the sample can reach 70±1.5%, and the axial tensile strength and elongation can reach 12±1.4MPa and 10±1.8%, respectively. This study provides a novel strategy for designing strong wood-based hydrogels, which opens a versatile route for the development of new wood nanotechnology and various functional wood-based materials.

Keywords: Cellulose skeleton, Polyacrylamide, Wood, Flexibility, Mechanical properties

P062

Characterization of carbon quantum dots combined with chitosan (CS) and polyvinyl alcohol (PVA): preparation of transparent UV-barrier membrane

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Carbon quantum dots (CQDs) have attracted tremendous attention for their prominent fluorescence, excellent stability, and outstanding biocompatibility. CQDs (1-CQDs, 2-CQDs) were obtained via hydrothermal reaction from walnut shells. The morphology, optical and light absorption properties were evaluated by HR-TEM, FL, UV-Vis, respectively. The as-prepared 1-CQDs (2-CQDs) particles with diameter of 3.2nm (4.3nm) with a highly UV absorbing property. Both 1-CQDs and 2-CQDs capable of absorbing energy and ultraviolet energy converter, blue and green photoluminescence transmission range. XPS and FT-IR analysis showed an oxygen-rich content on the surface. The as-prepared CQDs were then added to PVA and CS. The morphology, optical and dynamics properties of PVA/CS/CQDs were evaluated by SEM, UV-Vis, mechanical testing machine, respectively. This blending method effectively reinforces the CQDs structure. Toughness, puncture strength, and water tolerance were measured to assess the effect of PVA and CS on the analyzed properties. Results showed CQDs could be well dispersed and the membranes have good UV-barrier properties. The unique CS structure provides an expanded surface area with high porosity, easing the combination with other soluble polymers by solution mixing. The PVA/CS/ 2-CQDs film with a volume ratio of 1:2:4 has the best UV blocking performance, which can block 89% UV light.

Keywords: carbon quantum dots, UV-barrier, composite materials

P063

Using wood flour biochar as the support to enhance the visible-light photocatalysis performance of BiOBr for organic pollutant degradation

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In the present study, green and low-cost composite photocatalysts based on wood flour biochar incorporated bismuth oxybromide (WFB/BiOBr) were prepared and applied in the photo-degradation of organic pollutants in water under visible-light. Specifically, the impact of WFB pyrolysis temperature on the photo-degradation performance of the WFB/BiOBr was systematically studied through degrading rhodamine B dye (RhB). The results indicated that when the pyrolysis temperature was 600^{o}C, the prepared WFB (600-WFB) had the highest degree of graphitization, with abundant and uniform mesoporous structures. The following RhB degradation results indicated that the WFB significantly enhanced the visible-light photocatalysis performance of the BiOBr. Having higher graphitization degree, the 600-WFB/BiOBr exhibited the strongest photo-degradation capability. The overall results indicated that the WFB is a promising alternative to replace traditional carbonaceous materials. A novel approach is also proposed for the design of green, inexpensive and high-efficient visible-light photocatalysts for environmental remediation by utilizing industrial biomass waste.

Keywords: Wood flour biochar, pyrolysis, visible-light photocatalyst, BiOBr, pollutant degradation

P064

Core-shell Structure Nature Fiber Reinforced Polymer Composites via Co- extrusion Technology

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The shell layer plays a decisive role in the modification of co-extrusion wood-plastic composites (WPCs). In order to balance the manufacturing cost, processing efficiency and product performance, it's necessary to optimize shell materials of core-shell shaped WPCs. High-density polyethylene (HDPE) composites filled with talc, nano clay, glass fibers (GFs) and cellulose nanofibers (CNFs) reinforcing fillers were successfully prepared and their mechanical, morphological and thermal properties characterized. The results show that compared to pure HDPE shell layer, incorporating nature fiber fillers into HDPE matrix greatly improved the flexural and thermal expansion properties of co-extruded WPCs, but the linear coefficient of thermal expansion (LCTE) values of composites with shell reinforced fillers added had reduced. Cone calorimetry analysis indicated that flammability performance of core-shell structured composites distinctly enhanced as the filler content increased in the shell layer over a WPC core. The existence of the core-shell structured composites was beneficial to improve the impact strength and thermal properties of the material, and the stability of the materials were enhanced.

Keywords: Co-extrusion technology, natural fiber, Core-shell Structure, coextruded WPCs

P065

Functional Interface Construction of Cellulose

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The preparation of adsorbent materials with high adsorption capacity, environmental friendliness, economy and easy recycling has become one of the most concerned scientific issues for chemical researchers. Cellulose nanofibrils (CNF) possess a series of merits such as high specific area, renewability and degradability, its aerogel materials with high porosity, high chemical and thermal stability are promising precursors for functional adsorbent preparation. Thus, the construction of functional interface on CNF is of great significance in fields of pollutant disposal. The interface PAF-1@CNF with the ability of adsorbing BPA and the interface ODA-PDA@CNF with the ability of oil/water separation were achieved by solution blending, assisted by freeze-drying, composite aerogels with corresponding function was obtained. PAF-1@CNF aerogels has BPA adsorption capacity of 1000 mg g-1, ODA-PDA@CNF aerogels can absorb organic solvent 172 times as its own weight.

Keywords: cellulose, functional interface, BPA, oil-water separation, adsorb, aerogel

P066

Research of Preparation and Mechanical Performance of oil palm trunk Plywood by Phenol-formaldehyde resin impregnation

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Oil palm trunk plywood was prepared by PF resin impregnation in this study. The weight percentage gain (resin uptake) and the residual volatiles matter, surface wettability of veneers during pretreatment were investigated. On this basis, the influence of hot-pressing parameters (temperature, time) on mechanical performance were explored to determine the optimum process. Finally, the influence of lay-patterns on mechanical performance of board were studied. The results showed that, weight percentage gain and residual volatiles matter of low-density veneer was higher than high-density one under the same pretreatment process. The contact angle of PF resin on pretreated low-density veneer was lower than those of high-density. Low-density veneer after pretreatment had higher spreading permeability coefficient (K value) and better surface wettability. The optimum hot-pressing temperature and time was respectively 140℃ and 110s/mm. Moreover, setting high-density veneer away from the core layer and those of low density in core increased the MOE and MOR, and reduced the profile strain distribution of board under loading

Keywords: Oil palm, Plywood, Mechanical performance, Phenol-formaldehyde, Resin impregnation

P067

Seasonal Changes of The Dynamic Viscosity of Xylem Sap in Poplar and Metasequoia

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Xylem is an important tissue of trees to transport water from roots to leaves. In order to understand the water transport process in the xylem, it is worthy to study the seasonal changes of the dynamic viscosity of xylem sap. The influence of temperature, the chemical components and their contents of xylem sap on the dynamic viscosity of xylem sap during the growth process of trees was also analyzed. The xylem sap of poplar and metasequoia was collected once a month from September, 2018 to August, 2019. The dynamic viscosity was measured using capillary method. The contents of sugar and acid components in poplar and metasequoia were measured by GC-MS and HPLC. The results showed that the dynamic viscosities of xylem sap of metasequoia in a whole year were higher than those of poplar. Viscosity was closely related to temperature, and the viscosities of poplar and metasequoia decreased with the increase of temperature. The main components of xylem sap of poplar and metasequoia were glucose, palmitic acid and oleic acid.

Keywords: Viscosity, xylem sap, poplar, metasequoia, chemical component

P068

Cell and metabolite changes in forming tissues of *cunninghamia lanceolata* after dormancy

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To explore the life activities of wood forming tissues after the dormant period of trees was relieved, samples of *cunninghamia lanceolata* from 4 points on March 2, March 12, March 23 and April 13 were selected. The microscopic sections of plant tissues were made by paraffin embedding technique to observe the life activities of cambium cells. Metabolites in xylem and secondary phloem surface cells were extracted by methanol/chloroform organic solvent system, and their components were identified and calculated by GC-MS. The results showed that:(1) the dormant stage of *cunninghadum lanceolata* was lifted on March 28, and the meristem activity of cambium phloem mother cells was earlier than that of xylem mother cells. (2) there are 36 secondary metabolites in newly formed xylem cells; There were 41 secondary metabolites in the newly formed phloem cells. There are 28 kinds of cross metabolites in xylem and phloem. Most of the metabolites of sugars and organic acids in xylem and phloem decrease rapidly with the release of dormant period. Alcohols and lipid metabolites decreased first and then increased.

Keywords: *Cunninghamia*, *lanceolata*, wood forming tissue, Paraffin sectioning, metabolites, GC-MS

P069

Degradation Behavior and Protection Methods of *Cunninghamia lanceolate* Following Natural Weathering

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Wood degradation behavior information is needed to establish the deployment plan of wood weatherproofing and to improve wood utilization. The degradation behavior of *Cunninghamia lanceolate* (Lamb.) Hook. was different in radial and axial directions, and it was weakened from juvenile wood to mature wood and enhanced from the bottom. The degradation of mature and juvenile wood was significant, and the mature material was more resistant to weathering, indicating that juvenile wood is not suitable for outdoor building materials. To quickly clarify the effect of heat treatment on weatherability of *Cunninghamia lanceolate*, we investigated the surface degradation under natural exposure. The results also indicate that the wood surface color stability was improved via the proper temperature of thermal modification. From the beginning of the weathering process, the heat treatment affected the surface structural stability. After natural exposure, the degree of wood structure decay followed the pattern 220 ◦C heat-treated > 190 ◦C heat-treated > untreated. Therefore, when considering the impact on the structure, thermal modification treatment as a protective measure to prevent weathering was not an ideal approach and requires further improvement.

Keywords: *Cunninghamia lanceolate*, degradation behavior, heat-treated, natural weathering

P070

Basic research on paleoclimate reconstruction using teak tree-rings collected from Bago Mountains, Myanmar

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In Myanmar, there are few past meteorological data, so an alternative indicator of paleoclimate reconstruction is necessary to obtain long-term weather information. In this study, we examined whether teak tree-rings in Myanmar could be a climate proxy for paleoclimate reconstruction. We measured the annual ring width and cellulose oxygen isotopic composition (δ18O) of 6 teak individuals (95-96 annual rings, logging in 2001-2003) collected in Bago Mountains in central Myanmar and investigated the relationships between them and precipitation. As a result, the annual ring width had a significant positive correlation with the precipitation during rainy season. Moreover, in comparison with monthly precipitation, there were stronger positive correlations with precipitation in late rainy season, August or September. These results suggest that teak annual ring width well reflects precipitation and might be a useful tool for rainfall reconstruction in central Myanmar. On the other hand, there was no significant correlation between cellulose δ18O and precipitation, suggesting that cellulose δ18O may be difficult to utilize as a climate proxy in central Myanmar.

Keywords: Paleoclimatology, Myanmar, Teak, Tree-ring

P071

Research on Cambium Activity rule in *Taxodium* hybrid'Zhongshanshan302' and *Taxodium distichum*

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Studies on seasonal activity of vascular cambium can not only provide critical data for understanding the growth dynamics of trees, but also help to variety breeding. ‘Zhongshanshan302’is an excellent interspecific hybridization species of *Taxodium*. In order to reveal the difference of cambium activity rule, the cambium activity rule of 25 -year-old ‘Zhongshanshan302’ and *Taxodium distichum* were observed by microscope and electron microscope. Results showed that（1）The cambium activities of ‘Zhongshanshan302’ and *Taxodium distichum* had significant periodicity. The cambium activities of ‘Zhongshanshan302’ was recovered at the end of March, Cambium are activity at the end of June, November to February enter the period of dormancy. The cambium activities of *Taxodium distichum* was recovered and activity earlier than ‘Zhongshanshan302’ half a month.（2）The phloem cell division earlier than xylem cell division in *Taxodium* hybrid ‘Zhongshanshan302’ and *Taxodium distichum*. At the end of March, the activities of phloem mother cell of ‘Zhongshanshan302’ was recovered, the activities of xylem mother cell was recovered at the middle of May. The phloem and xylem cell division of *Taxodium distichum* was earlier than ‘Zhongshanshan302’ half a month.（3）The amount of cell growth in same issue were different. An incrase of 6~7 layers of phloem cells were characterized during the active period for ‘Zhongshanshan302’, while 8~9 layers were observed for *Taxodium distichum.* An increase of 33 layers of xylem cells were characterized during the active period for ‘Zhongshanshan302’, while 45 layers were observed for *Taxodium distichum.*

Keywords: *Taxodium* hybrid‘Zhongshanshan302’, *Taxodium distichum*, Vascular cambium

P072

Study on physicochemical properties and pyrolysis characteristics of torrefied cellulose

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The effects of torrefaction on the physicochemical properties and pyrolysis behavior of cellulose were studied. The results showed that torrefaction had a great effect on the physicochemical properties of cellulose, and reduced the O/C ratio of cellulose and increased the fuel value of cellulose. Torrefaction changes the crystal structure of cellulose. The crystallinity of cellulose increases slightly with the torrefaction of the temperature, and then decreases sharply with the increase of crystallinity, which can be attributed to the degradation of competition between crystals. In addition, torrefaction has the effect of the cellulose pyrolysis characteristics. The original cellulose by thermogravimetric analysis and torrefaction cellulose weight loss situation, through the dynamic response of distributed activation energy model explain the cracking glycosidic bond β-1,4-and hydroxyl dehydration reaction is the main content, cellulose structure changes of kinetic parameters have great influence; torrefaction temperature also changed the distribution of pyrolysis products. The organic components of cellulose pyrolysis were mainly furans and dehydrated sugar. Maximum value of furans reached 18.16% at 290℃, and the minimum value of dehydrated sugars reached 21.05% at 290℃.

Keywords: Cellulose, Torrefaction, Physical and chemical properties, Rapid pyrolysis, Kinetics

P073

Maximizing enzymatic hydrolysis efficiency of lignocellulosic biomass with a novel delignification system at 100 °C

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This study highlighted a novel delignification pretreatment at low temperature that maximized the enzymatic hydrolysis efficiency of bamboo with the introduction of ethanol into the pretreatment system. The pretreatment caused significant lignin removal of bamboo at elevated pretreatment temperature with a highest lignin removal of 80.04% at 100 °C, higher than that (75.53% lignin removal) in pretreatment without ethanol assistance. Besides, certain amount of carbohydrates were also solubilized during the process whose recovery were 83.30% (glucan) and 67.55% (hemicellulose), respectively, at 100 °C. The pretreated solid exhibited excellent enzymatic digestibility, with hydrolysis yields of ~100% and 95.66% for glucan and xylan, respectively. Our further study indicated that this delignification system is versatile for hardwood and herbaceous plants, but cannot work well with softwood.

Keywords: Bamboo, low temperature, delignification, enzymatic hydrolysis

P074

Study on Pyrolysis Characteristics and product quality of pickled rice straw based on TG-FTIR and Py-GC/MS

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In this study, the effects of washing pretreatment on pyrolysis behavior and kinetics of rice straw were studied by using three different washing solutions: water (H_2O), dilute hydrochloric acid (HCl) and aquatic bio-oil (APBO).Thermogravimetric infrared spectrometry (TG-FTIR) and pyrolysis-gas chromatography mass spectrometry (Py-GC/MS) were used to conduct pyrolysis experiments or comparative analysis of raw materials (Raw-RS) and rice straw samples of washing pretreatment(H_2O-RS, HCl-RS and ABBO-RS), respectively.It was found that among the three washing pretreatments, APBO washing pretreatment had the highest removal rate of AAEMs.By studying the evolution of volatiles (hydrogen peroxide, CH_4, CO, CO_2 and C=O stretching), it was found that after APBO and HCl washing pretreatment, the adsorption strength of components increased.After APBO washing pretreatment, rice straw showed the highest activation energy (354.96-373.43 kJ/mol) in the main pyrolysis area, followed by HCl and H_2O washing pretreatment.By washing pretreatment, most of the AAEMs in rice straw were removed, and subsequent pyrolysis experiments reduced the contents of acids, ketones, furans and phenols in bio-oil of pyrolysis liquid products which also increased the content of dehydrated sugar (mainly levoglucose).

Keywords: bio-oil, alkali metal, pyrolysis, pretreatment, acid pickling

P075

One-pot synthesis of a lightweight effective absorber, Fe/Fe_3O_4@C for electromagnetic wave energy conversion, via in situ carbonization of Fe_3O_4-lignin framework

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Along with the quick development of electronic devices and communication technology, it is widely accepted that we need an ideal electromagnetic wave (EMW) absorber to solve the electromagnetic interference (EMI) irradiation pollution. Here, we successfully synthesized graphite/Fe_3O_4/Fe composites (GFF) by carbonizing Fe_3O_4-lignin frameworks which were prepared through a two-step carbodiimide coupling protocol. The in-depth investigation confirmed the composites were Fe/Fe_3O_4 core/shell particles inlaid in graphite-like matrix. The obtained GFF displayed excellent EMW absorbing performance with a minimum value of -47.11 dB and a wide response bandwidth (reflection loss of less than -10 dB) of 5.64 GHz. This excellent performance is attributed to the optimal dielectric loss caused by the dipolar and multiple interfacial polarization, migration and hopping of electrons in the graphite-like carbonized matrix, and to the optimal magnetic loss from natural resonance and exchange resonance of the inlaid Fe/Fe_3O_4 core-shell nanoparticles in the matrix. Besides, the carbon matrix with a certain graphite degree effectively regulates the complex permittivity and permeability to ensure the impedance matching characteristic as well as enhance the attenuation ability through the multiple reflections and scatterings among the inlaid Fe/Fe_3O_4 core-shell nanoparticles.

Keywords: pyrolysis, magnetic, core-shell, electromagnetic wave absorption, composite

P076

Oxidative torrefaction of cellulose and the effects of oxygen concentration on pyrolysis characteristics of its solid product

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In this study,in an attempt to evaluate the effect of the oxygen concentration on pyrolysis characteristics of torrefacted soild product by thermogravimetic analyzer, torrefaction on cellulose under oxidative atmospheres with the different oxygen concentration (0,3,5,8,10,15,21%) was studied.The results show that the oxygen has positive influence on torrefaction and the oxygen content of solid products decreased from 50.6% to 46.04%. According to TG and DTG curves, the increase of oxygen concentration leads to an increase in the temperature range during the rapid pyrolysis period of solid products. Meanwhile, the TG curve shifts to the left, which reduces the maximum weight loss rate and increases the mass residue. In addition, the kinetic analysis of the solid products was conducted by using KAS, FWO and FM methods calculating the activation energies of DTG data with different heating rates. The results showed that the activation energies calculated by the three methods were consistent, ranging from 180kJ/mol to 205J/mol.

Keywords: cellulose, oxidative torrefaction, kinetics pyrolysis

P077

UIO-66-Cellulose composites as high ionic conductivity gel electrolyte for lithium ion batteries

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Developing a gel polymer electrolyte (GPE) combining with superior mechanical strength and lithium-ion transportation properties is still a challenge. Herein, a new GPE based on UIO-66 Metal–organic frameworks (MOFs), also known as porous coordination polymers, and cross-linked cellulose structure is prepared. The results showed that the composite gel membrane owned superior tensile strength from 33.92 MPa to 211.06 MPa and bending resistance when the content of UIO-66 was changed from 2.5% to 10%. It exhibited considerable ionic conductivity of 1.31×10^{-3} S cm^{-1}, together with an outstanding lithium-ion transfer number of 0.55 when the content of UIO-66 was at 5%. The assembled Li/GPE/NCM523 batteries by this gel polymer electrolyte demonstrated initial dis-charge capacity of 156.4 mAh g^{-1} as well as the coulomb efficiency of 85.52% at 0.2C. Moreover, the as-prepared GPEs possessed good affinity with electrodes. Combing the high performance and optimized mechanical strength, we anticipate the possibility of this cost-effective and biodegradable GPE membranes applied in LIBs can be achieved.

Keywords: Gel polymer electrolyte, Cellulose, UIO-66, Lithium ion battery

P078

Interactions between volatiles and char during biomass pyrolysis: A case study of α-O-4 lignin model compound and functionalized graphitized carbon nanotubes

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The secondary reactions during biomass pyrolysis are quite complicated and need more attention. This study employs the Py-GC/MS detection technique to investigate interactions between volatiles and char during biomass pyrolysis at 400 °C using benzyl phenyl ether (BPE) and different graphitized carbon nanotubes (GCNT, CNT-COOH, CNT-OH, and CNT-NH2) as model compounds, respectively. The results show the BPE conversion increases from 0.1% (blank run) to 49.2% (with GCNT), to 55.1% (with CNT-COOH), to 61.3% (with CNT-OH), and to 70.2% (with CNT-NH2), resulting from π-π stacking of aromatic rings between BPE and carbon nanotubes as well as hydrogen bond forming between BPE and heteroatoms in functional groups. The cleavage of Cα-O is promoted to mainly produce phenol and toluene by all kinds of interactions mentioned above. In the case of CNT-NH2, Caryl-O breakage is also facilitated by the synergistic effect of hydrogen bond and aromatic-hydrogen interactions.

Keywords: Biomass pyrolysis, Lignin model compound, BPE, Carbon nanotubes

P079

Study on PAE Soybean Adhesive for Plywood

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In this work, adipic acid (AA), diethylenetriamine, epichlorohydrin (ECH) is used to synthesize polyamide polyamine epichlorohydrin resin (PAE), which is mixed with soybean protein to prepare PAE soybean adhesive. After synthesizing the prepolymer (PA), the single-factor experiment was conducted to explore the molar ratio of AA to ECH, the effect of the amount of soy protein added on the bonding strength of the plywood, and finally determine the optimal synthesis process. The hot pressing process of PAE soybean adhesive plywood was discussed. The reaction mechanism was used to explain the modification effect and bonding mechanism of PAE on soybean protein. The results showed that the molar ratio of AA to ECH was 1:1.0 during the synthesis, the amount of soy protein added was 30% (relative to the quality of PAE), and the optimum bonding performance was obtained by hot pressing at 120 °C for 6 min. PAE soy protein adhesive, The bonding strength can meet the requirements of national enamel board (greater than 1.0 MPa).

Keywords: PAE resin, PAE soy protein adhesive, Water resistance, Glue strength

P080

Study on bonding properties of poplar modified by amino resin impregnation

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Structural gluing wood is widely used in indoor and outdoor as well as Bridges, buildings and other engineering fields. The adhesives used in outdoor buildings have high requirements for the adhesives. At present, modified poplar wood impregnated with amino resin used in wood structure buildings is difficult to be bonded and water resistant, and it is difficult to be used in outdoor wood structure buildings. Therefore, the requirements for adhesives are very high. Two kinds of adhesives were used in this experiment: resorcinol formaldehyde (RF) resin and high polymer water isocyanate (API) adhesives. By testing the wet shear strength of the two adhesives, the bonding strength of the two adhesives is compared to determine which one is more suitable for outdoor construction. The results showed that the molar ratio of formaldehyde to resorcinol was 0.8:1, the ratio of resin to curing agent was 10:3, and the cold pressing time was 1 h, the wet shear strength of the adhesive was 4.59 MPa, and the bonding performance was good. Compared with API resin, the adhesive was more suitable for outdoor buildings.

Keywords: Wet shear strength, Impregnated Poplar, Resorcinol formaldehyde resin adhesive, Polymer Waterborne Isocyanate Adhesive

P081

Study on Modified Melamine-formaldehyde Resin Impregnated Poplar Floor Triple Layer Decoration

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In this study, the modified melamine formaldehyde resin (SMF) was prepared by the reaction of natural green product sucrose as modifier with melamine and formaldehyde.Experiments were conducted to explore the effect of sucrose content on MF storage days and resin properties, as well as the physical and chemical properties of melamine-formaldehyde resin impregnated thin wood veneer, three-layer poplar floor surface abrasion resistance, formaldehyde release, and physical properties of impregnated thin wood.The results showed that when the molar ratio of formaldehyde to melamine was 1.8 and the content of sucrose was 20% of the mass of melamine, the storage days of the modified melamine formaldehyde resin could reach 15 days.The cladding process is as follows: when the hot-pressing time is 90 s, the hot-pressing pressure is 1.0mpa, and the hot-pressing temperature is 180°C, the addition amount of aluminum trioxide is 30 g/m^2. The grinding revolution of the surface of the veneer is up to 3,200 revolutions, and the physical and chemical properties of the three-layer poplar flooring reach the standard of GB/T15102-2006 《Impregnated paper veneer wood-based board》.

Keywords: melamine resin, sucrose, modification, impregnated veneer

P082

Study on combustion characteristics of granular fuel prepared from bamboo residue

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(1) According to the industrial analysis, the moisture content of bamboo particle fuel is low, about 6%, ash content is very low, about 1.5%, volatile content is the highest, about 77%. These characteristics are conducive to the rapid ignition and combustion of bamboo particle fuel, and easy to burn out, and the combustion process produces less solid waste and toxic gas.
(2) By measuring the calorific value, it can be seen that the calorific value of bamboo particle fuel reaches 20188J/g, which has already exceeded the calorific value standard of category ii bituminous coal. Therefore, it meets the standard of biomass raw material as fuel.
(3) Through the test the bamboo pellet fuel combustion rate, put bamboo particles in the muffle furnace of 600 ℃, at 0-1.5 min, combustion reaction, the relative efficiency of 96.05%, within 1.5 3 min, burning rate is reduced, the relative efficiency dropped to 3.42%, within the 3-4.5 min, burning ground to a halt, relative burning rate is only 0.63%.

Keywords: bamboo processing residues, Granular fuel, Combustion characteristic

P083

Catalytic ketonization of levoglucosan over nano-CeO_2 for production of hydrocarbon precursors

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With the increasing demands for renewable energy and the growing concerns on environmental pollution, significant attention has been paid to the recovery of energy and chemicals from renewable biomass *via* pyrolysis. As one of the main component of biomass, cellulose produces a lot of highly-oxygenated levoglucosan (LG) during pyrolysis, which is not conducive to the utilization of direct pyrolysis products. In this study, catalytic deoxygenation of LG over nano-CeO_2 was performed in a pyrolyzer-gas chromatography/ mass spectrometry (PY-GC/MS) system under moderate temperature to prepare hydrocarbon precursors (principally ketones). The results showed that in the absence of nano-CeO_2, most LG remained undecomposed at 600℃, indicating the thermal stability of LG. When CeO_2 to LG mass ratio increased from 0:1 to 2:1, the peak area (PA) of LG changed slightly within 1.62×10^{10} - 1.76×10^{10}. Further increase in CeO_2 dosage caused an elimination of LG. On the contrary, the PA of ketones increased from 9×10^7 to 3.8×10^9 along with the increase in CeO_2 to LG mass ratio from 0:1 to 4:1. It is indicated that LG is degraded to produce ketones over the catalysis of nano-CeO_2. The process was promoted at higher pyrolysis temperature, as illustrated in Fig. 2. In detail, when the pyrolysis temperature increased from 500℃ to 700℃, the PA of LG dropped from 2.11×10^{10} to 0. Conversely, the PA of ketones increased slightly from 2.71×10^9 to 3.34×10^9 as the pyrolysis temperature increased from 500℃ to 650℃, but decreased to 3.11×10^9 when the temperature raised to 700℃. It is because that LG produces small-molecule gas or coke over the nano-CeO_2 catalyst at the pyrolysis temperature of 700℃, indicating that it is unsuitable to collect condensable liquid products at 700℃. Moreover, it was interesting that cyclic hydrocarbons (cycloalkenes and toluene) and alkyl phenols were also detected upon the addition of nano-CeO_2. Therefore, over the catalysis of nano-CeO_2, LG can be effectively converted to valuable chemicals like ketones, which are important hydrocarbon precursors and widely-used organic solvents. It is proved that cerium oxide may possesses a big potential to convert cellulose into biofuels in a very sustainable way.

Keywords: Hydrocarbon precursors, ketonization, levoglucosan, nano-CeO_2.

P084

Pyrolysis Experiment and Research of Soybean Straw Briquette

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In this paper, anthracite and soybean straw are used as experimental materials. Firstly, elemental analysis and industrial analysis of the two raw materials were carried out respectively. Then anthracite and soybean straw were mixed proportionally. By changing the heating rate and particle size of soybean straw briquette of soybean straw pyrolysis analysis. The pyrolysis process was studied by synchronous thermal analyzer. After plotting the curves of pyrolysis (TG and DTG), the pyrolysis process of soybean straw briquette was analyzed. The pyrolysis characteristic index and pyrolysis kinetics parameters were calculated.

The results show that: The pyrolysis process of soybean straw briquette can be divided into three stages. They are the slow drying stage, rapid pyrolysis stage and carbonization stage. In the case of increasing properly the proportion of soybean straw, it is conducive to pyrolysis. When the heating rate is 30K/min, the pyrolysis rate of the test is very fast and the residual weight is less. The activation energy E of the main pyrolysis stage is in the range of 30-40 kJ/mol. And the correlation coefficients after fitting are all near 1. That is to say, the selected mechanism function basically conforms to the pyrolysis mechanism of soybean straw briquette.

Keywords: fuel characteristics, pyrolysis, kinetics, biomass

P085

Research on Combustion Characteristics of Flame-retardant Wood-based Panels

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With the gradual improvement of science and technology, the production of wood-based panels has been paid more and more attention. Also, there are many researches on flame-retardant wood-based panels, which are of great significance to the treatment of fire-retardant wood-based panels waste and the test of fire-retardant properties of wood-based panels. In this research, inorganic composite wood-based panels were used. The inorganic layer of the wood-based fiberboard is mainly composed of magnesia. It has good flame-retardant performance. The combustion characteristics of flame-retardant wood-based panels were studied by proximate analysis and thermogravimetric analysis. Through the industrial analysis of the fire-retardant wood-based panels, the moisture, ash, volatile matter and fixed carbon content of the wood-based panels were measured by experiments, and compared with poplar. The influence of the fire-retardant inorganic layer on its combustion characteristics was obtained. The pyrolysis and combustion characteristics of the flame-retardant wood-based panels were obtained by comparing the thermogravimetric curves of the flame-retardant wood-based panels with those of polar. Thermogravimetric analysis was carried out under nitrogen and air conditions respectively with different heating rates. Finally, the combustion characteristics of the fire-retardant wood-based panels were obtained.

Keywords: Flame-retardant wood-based panels, combustion characteristics, proximate analysis, thermogravimetric analysis

P086

Study on the pyrolysis mechanism of lignin based on the β-5 linkage model compound

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Lignin, as a three-dimensional amorphous polymer, has a complex chemical structure. In order to understand the formation path of products in the pyrolysis process, the most typical C-C bond (β-5 linkage) model compound in softwood lignin was studied in detail by using Py-GC/MS at different pyrolysis temperatures. The results showed that C-O bond of β-5 linkage model compound was easily broken and the resulting products were still mainly dimers at low temperature. With increasing of pyrolysis temperature, the dimers underwent secondary cracking to form a large number of small molecular aromatic compounds, and polycyclic aromatic hydrocarbons (e.g., naphthalene and indene) were also formed by polymerization.

Keywords: Lignin, β-5 linkage, Model Compounds, Pyrolysis

P087

Biomass carbon high added value utilization

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Among the all kinds of pharmaceuticals, antibiotics are particular attributed to work on pathogens meanwhile do not influence to human tissues and cells selectively. In order to control infectious diseases caused by pathogens, antibiotics are often used to as animal feed additives to promote healthy growth. In 2013, the annual consumption of antibiotics in China reached 162000 tons, nearly half of which came from animals. But because animals can only absorb part of the antibiotics, more is excreted in faeces and urine and that is the reason why the environmental concentration of antibiotics increased a lot.

The purpose of this work is to prepare, test and characterize the tetracycline adsorption properties of waste fiberboard biochar. The effects of temperature, TC initial concentration, pyrolysis temperature of biochar, biochar dosage and NaCl concentration on TC removal were investigated. At the same time, biochar was washed with different solutions and then biochar and residual solutions were collected for adsorption experiments to investigate the adsorption mechanism and determine what substances contained in biochar are playing an important role in the adsorption process. In this study, we aimed to provide an overall understanding of the design and improvement of biochar adsorption antibiotics removal system.

The vibration characteristics of functional groups in biological bodies can be reflected by infrared adsorption spectra. In this study, infrared spectra of biochar samples in the transmission mode of 4000-400 cm^{-1} were recorded. The peaks at wavenumber 3434 cm^{-1} represents the stretching of hydroxyl (-OH) groups of biochar structure, while the peak value of biochar treated by washing decreased significantly, manifesting that the chemical condition of -OH groups changed a lot after washing treatment. In addition, we also found that with the increase Of pyrolysis carbonization temperature, the content of -OH on the surface of biochar decreased, leading to the decrease of negative charge on the surface of biochar, which may be related to its adsorption capacity.

P088

Preparation and application of resorcinol-furfural porous resin by soft template method

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In this study, phenolic hydrogel with porous structure was prepared from resorcinol-furfural using deep eutectic solvents (DES)\water as soft template. The chemical functional group structure, thermal stability, curing reaction, microstructure, density, porosity and dye-adsorption properties were characterized. This is an environmentally friendly and cost-effective material.

Through the experiment, we come to the following conclusions:

(1) A homogeneous phenolic resin hydrogel with low resin concentration (20%) was obtained, while presenting very high porosity.

(2) Through curing kinetics analysis, the activation energy increased with the DES content, which is more conducive to the curing reaction.

(3) The kinetics of dye-adsorption was simulated at resin content lower than 40%, indicating a fast adsorption rate.

Keywords: phenolic hydrogel, soft template, dye-adsorption, curing kinetics, adsorption kinetics

P089

Lignin-based antiviral inhibitor produced by microwave glycerolysis from sugarcane bagasse

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Viruses cause severe damage to human and animal health, and the threat is rapidly increasing by global warming and globalization of transportation. Thus far, natural bioactive compounds including antiviral substances have been studied extensively. Although intense attention has been paid to natural bioactive metabolites from plants, plant cell wall components composed of cellulose, hemicelluloses and lignin, have not been expected as a raw material to obtain bioactive agents. Generally, lignocellulosic biomass is regarded as resources for energy, bio-fuels and platform chemicals. However, in this study, we found a chemical reaction producing antiviral lignin from sugarcane bagasse, one of the most abundant lignocellulosic agricultural residues. The antiviral lignin was produced by microwave acidic aqueous glycerolysis. The degraded lignin strongly inhibited replication of encephalomyocarditis virus by direct contact with the virion. Furthermore, we revealed that severe alteration of the native lignin structure triggered emerging the antiviral activity. Our finding should maximize the value of lignocellulosic biomass and offer a great contribution towards societal implementation of lignocellulosic biorefinery.

Keywords: Antiviral agents, Sugarcane bagasse, Lignin, Glycerolysis, Microwave degradation

P090

A mild alkaline condition for preparing pig blood adhesive with an ultrasound bath

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Blood has a high protein content and is primarily used as animal feed with low value added after related processing. In addition, blood has been used to eco-friendly composite materials, like bio-plastics. And at present, most attention has been paid to the chemical modification of blood proteins due to the mature soy protein adhesive technology in the few studies on the preparation of adhesives from pig blood. However, excessive chemical reagents will cause great damage to the environment. In contrast, ultrasound treatment is a mild and eco-friendly modification method. In this study, a renewable and environmental pig blood adhesive (PBA) was obtained by modification with a mild alkaline solution, glutaraldehyde and ultrasound. The basic properties, thermal degradation behavior, chemical structure, interface morphology and bonding properties of those modified PBAs were characterized. The experimental results showed that the alkaline solution could unfold the structure of blood protein, while glutaraldehyde crosslinked the blood protein. The ultrasound might inevitably destroy the crosslinked structure formed by both glutaraldehyde and protein but can greatly help increase the degree of expansion of the protein under a weak basic condition.

Keywords: eco-friendly, pig blood adhesive, ultrasound, crosslinked structure, bonding interface

P091

Effect of leaching pretreatment with light bio-oil and acetic acid on the pyrolysis poly-generation of moso bamboo

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The pyrolysis characteristics and the quality of products of raw moso bamboo (MB), acetic acid solution leached moso bamboo (AA-MB), and light bio-oil leached moso bamboo (LB-MB) were comparatively studied using thermogravimetric analysis (TGA) and a fixed bed react. Results showed that removal efficiency of AAEMs by light bio-oil was higher than that by acetic acid solution at the same pH 3. The maximum mass loss rate and its corresponding temperature increased by the leaching pretreatments, leading to a higher mass loss of moso bamboo. Compared to the MB, the TG and DTG curves of AA-MB and LB-MB shifted to the high temperature region with higher activation energies in the majority region of conversion rate, especially for the LB-MB. In terms of liquid products issued form pyrolysis of MB, AA-MB and LB-MB, the bio-oil from LB-MB had the lowest water content (43.5 wt.%) and relative content acids (11.7%) while the highest mass yield (60.2 wt.%), heating value (16.9 MJ/kg), and the relative content of levoglucosan (17.5%). It reduced the mass yield and ash content of biochar while promoted the formation of combustible gas components such as CO, CH4 and H2, leading to an increasing in heating value of non-condensable gases. It was as high as 61.2% for the biochar form MB, however, the energy yield of bio-oil form LB-MB became the dominant among the products. Therefore, the quality of products of LB-MB were generally better than those of MB and AA-MB, indicating that leaching with light bio-oil was a promising method to upgrade moso bamboo and its pyrolysis products.

Keywords: Biomass, Light bio-oil, Leaching, Moso bamboo, Pyrolysis

P092

Study on Synthesis and Mechanical Properties of Bio-polyurethanes

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The synthesis and properties characterization (mechanical and viscoelastic) of bio-polyurethane had been studied in this work. First, the bio-polyester polyol which used in this research has been synthesized by azelaic acid, sebacic acid, succinic acid and 1,3-propanediol(1,3-PD) with esterification synthesis method. The raw materials of bio-TPU(Thermoplastic Polyurethaene) samples' synthesis were shown in below : 1,4-butanediol(1,4-BD), 1,3-propanediol(1,3-PD), Isosorbide which used as chain extender and MDI(4,4'-methylenebis (phenyl isocyanate)), HDI which used as isocyanate. It also had been set the general polyurethane with SS-106 (Poly (1,4-butylene adipate)) as control groups. The viscoelastic behaviors of the bio-TPUs were explored using a rubber processing analyzer (RPA) in the mode of strain sweep. And the mechanical properties (tensile strength, hardness value, coefficient of friction, abrasion resistance) were characterized by UTM, Shore A tester, Coefficient of friction meter and Taber abrasion resistance tester. From the results above, the bio-TPU which synthesized in the research with bio- polyester polyol showed better abrasion resistance, elongation rate and viscoelastic properties compared to the general TPU.

Keywords: Bio-polyurethane, polyester, viscoelastic, abrasion resistance, mechanical properties

P093

Facile and ultrafast assembly of cellulose nanofibers reinforced graphene/polypyrrole microfibers for high performance supercapacitors

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With the widespread use of portable electronic devices, wireless sensor networks, and flexible displays, there is an increasing demand for energy storage devices. Compared with other energy storage devices, supercapacitors have attracted people's attention due to their high energy density, high power density and good cycle life. In this paper, a simple, low-cost impregnation polymerization method was used to prepare flexible, independent supercapacitor film electrodes. Cellulose nanofibers are both "enhancers" and "spacers"[5]. They not only provide a large number of hydrogen bonds to enhance the interlayer force, but also effectively prevent the stacking of graphene sheets. The process involves depositing a polypyrrole (PPy) coating on the surface and inside of a cellulose nanofiber (CNFs) / graphene (rGO) film. The electrochemical performance of the CNFs/rGO/PPy hybrid electrode was evaluated and compared with the CNFs/rGO thin film electrode. For the surface-grown CNFs/rGO/PPy nanocomposite electrode, the specific capacitance was 322 F/g at a scan rate of 3 mV/s. This value is higher than the specific capacitance of the CNFs/rGO electrode of 17.5 F /g. In addition, CNFs/rGO/PPy electrodes have excellent redox reversibility and cycle stability. This new process provides an effective method for achieving flexible, independent, high performance, low cost and environmentally friendly supercapacitor electrode materials.

Keywords: Cellulose nanofibers, supercapacitors, in-situ polymerization, electrochemical

P094

Microcrystalline cellulose torrefaction with the addition of calcium and magnesium salts

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To investigate the influencing mechanism of calcium and magnesium on solid products of biomass torrefaction, cellulose, one of the three biomass components, was selected as the feedstock and the experiments were carried out in the holding temperature range of 200 ~ 300 ℃, and in the atmosphere of nitrogen. Based on the impregnation (Calcium salts: $CaCl_2$, $Ca(OH)_2$ and $Ca(CH_3COO)_2$; impregnation concentration: 1.5% Ca. Magnesium salts: $MgCl_2$, $Mg(OH)_2$ and $Mg(CH_3COO)_2$, impregnation concentration: 0.9% Mg) methods, the results showed that the solid product yield of impregnated cellulose (whatever calcium or magnesium salts) torrefaction was lower than that of raw cellulose torrefaction at 200 ~ 275℃. However, it also can be found that these calcium salts or magnesium salts had more solid yields than raw cellulose at the torrefaction temperature of 300℃. The absorption peak intensity of solid products with addition of $Ca(OH)_2$ and $CaCl_2$ decreased, while the addition of $Ca(CH_3COO)_2$ inhibited the transformation of cellulose structure during torrefaction, and the absorption peak intensity of solid products with addition of $Mg(OH)_2$ and $MgCl_2$ decreased too. The impregnated calcium or magnesium salts reduced the crystallinity of cellulose. The impregnated calcium or magnesium salts reduced the activation energy of impregnated cellulose torrefaction process.

Keywords: calcium and magnesium salts, solid products, cellulose, torrefaction, kinetics

P095

In-depth investigation on the physical and chemical effects of phosphoric acid pretreatment on thermal degradation of pinewood (*Pinus tabuliformis Carr.*) via fast pyrolysis

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The physical and chemical effects of phosphoric acid pretreatment (PAP) on thermal degradation of pinewood (*Pinus tabuliformis Carr.*) were fully investigated by SEM, XRD, FTIR, TGA, kinetic analysis, and Py-GC/MS. Temperature (60, 80 and 100^{o}C), time (1,2 and 3h), and phosphoric acid concentration (0.5, 1, 2.5 and 5 wt. %) were selected as the main pretreating influence factors. Results indicated that PAP greatly changed the physicochemical properties of pinewood by significantly removing inorganic components, partially removing hemicelluloses, and damaging the weakly-bonded sites in the polymeric network constructed by three major components, resulting in the increase of crystallinity of pinewood. From TG and kinetic analyses results, it was found that thermostability of the pretreated pinewood was significantly enhanced. The highest average activation energy obtained for the pretreated sample was 155.47 kJ mol^{-1} versus 96.94 kJ mol^{-1} for raw pinewood. According to the Py-GC/MS results, the relative concentrations of furans, aldehydes, and ketones in the volatile pyrolysis products of pinewood decreased after PAP while the total relative acids and anhydrosugars contents increased from 12.46% and 13.78% for raw pinewood to the maximum values of 18.55% and 21.51%, respectively.

Keywords: pinewood, phosphoric acid pretreatment, pyrolysis kinetics, TGA, Py-GC/MS

P096

Study on Bleaching, Dyeing and Artificial Veneer of Birch

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China is short of precious timber resources, but the market for high-quality wood products is growing. In order to solve the contradiction between demand and supply, a large number of artificial thin wood is made. Birch is a relatively common tree species, rich in resources, easy to penetrate, suitable for the production of artificial thin wood. In view of this situation, the best process was selected through the research on bleaching, dyeing and fixing of birch veneer. Then, according to the requirements of the texture of the simulated tree species, the repaired dyed veneer color was selected and placed neatly according to its sequence. Then, the coating was carried out to select the best hot-pressing process. Finally, it is cut into the required size, packed and stored according to specifications, which will save a lot of high-quality wood and lay a foundation for application in production.

Keywords: Artificial veneer, Birch, Research status

P097

Structure-activity relationship of lignin for anti-UV radiation

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As a highly abundant natural and renewable aromatic polymers, lignin has been proven to be a good UV-absorber and a nature broad-spectrum sun blocker. However, the structure-activity relationship of lignin under UV radiation remains unclear due to lignins' complexity and heterogeneity. In this study, a series of model compounds including β–O–4, β–5, and β–β dimers, represent the structures of both technical lignins and native lignins, have been synthesized and applied for their anti-UV radiations studies by different methods including SPF values, antioxidant activities and UV absorbance. SPF values of all samples were increased differently with the same addition of each single model compound into the pure creams or commercial sunscreens. Especially for the commercial sunscreens, the addition of 2 wt % single model compound have greatly enhanced the SPF value of the sunscreens. By comparison, the addition of 2 wt % β–β-O dehydroferulic acid into commercial sunscreens showed the best synergistic effect that the SPF increased from 14.5 to 33.0, which might be caused by the long resonance structure of its intra-molecular. The difference between synergistic effect of adding different model compounds reflected, to some content, the structure-relationship of lignin for UV-radiation. In addition, DPPH assay of model compounds revealed that antioxidant activity of different models are closely related to their structures.

Keywords: lignin, model compound, sunscreen, UV absorbance

P098

The Development of Microwave Solvolysis Lignin for Antitumor Activity and Structure Analysis

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Our society is facing serious problems threatening human life and the environment. The excessive use of fossil fuels has caused energy crisis and global warming, which triggers the expansion of infectious diseases and extreme weather such as heavy regional rain. In order to overcome these problems towards establishment of sustainable society, it is essential to replace the fossil resources to a renewable carbons source, thereby decreasing the negative effects of carbon dioxide emission from fossil fuels.
Lignocellulosic biorefinery has attracted a great deal of attention due to its abundance and non-competitiveness to food supply. The production of bioactive substances from lignocelluloses increases feasibility of the biorefinery system and directly contributes to the health of humans and animals.
Based on this concept, we started the research on the production of bioactive substances from lignocelluloses by chemical reactions, and found that microwave solvolysis lignin possessed a high potential as an anti-tumor substance. To clarify the mechanism for antitumor activity and structure of the lignin, we further studied new microwave reactions and extraction methods. The newly separated lignin fractions were subjected to cell viability tests using twelve human tumor cell lines such as osteosarcoma and cervical carcinoma cells. From this screening test, a fraction inhibiting proliferation of tumor cells was found. The structural analysis and the further purification of the anticancer substance are now in progress.

Keywords: Antitumor, Lignin, Microwave reaction

P099

Electrospun Core-Shell Nanofibrous Membranes for Flexible Supercapacitor Electrordes

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A high-performance flexible supercapacitor electrode with a core-shell structure is successfully developed from a crosslinked polyvinyl alcohol (PVA)-polyacrylic acid (PAA) matrix, cellulose nanocrystal (CNC) stabilized carbon nanotubes (CNTs) as reinforcing/capacitive nanofillers and a conductive PANI coating layer. Thanks to the synergistic effect of the fiber alignment, core-shell configuration and thermally-induced crosslinking, the optimized PANI@CNT-CNC/PVA-PAA nanofibrous membranes with a high porosity (78.9%) and enhanced specific surface area (19.6 m^2 g^{-1}) demonstrate a remarkable tensile strength of ~54.8 MPa, a favorable electroconductivity of ~0.44 S m^{-1}, and an enhanced water resistance and thermal stability. More importantly, the core-shell designed nanofibrous electrodes have a high specific capacitance and an ideal cycle stability. The soft supercapacitor assembled by the nanofibrous electrodes shows an outstanding specific capacitance of 155.5 F g^{-1} and an outstanding capacitance retention of 92%, 90% and 89% after 2000 cycles under flat, bending and twisting deformations, respectively. Therefore, this work provides an alternative method for the facile preparation of the core-shell structured nanofibrous electrode which is promising candidates for flexible and lightweight supercapacitor applications.

Keywords: electrospinning, cellulose nanocrystals, flexible supercapacitor

P100

Impact of alterations in lignin aromatic composition on lignocellulose utilization properties: a model study using transgenic rice plants

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Lignocellulosic biomass represents viable resources for sustainable production of biofuels and biochemicals. Lignin is a complex aromatic polymer which accounts for 15-30% of typical lignocellulosic materials. The aromatic composition of lignins is considered an important trait that affects the physico-chemical properties of lignocellulosic biomass. However, our knowledge of the relationship between lignin structure and biomass utilization properties remains limited, especially in monocotyledonous grass species, despite their potential as biomass feedstocks. In this study, we used recently produced rice transgenic lines with distinct lignin monomer compositions, i.e., guaiacyl (G)/syringyl (S)/*p*-hydroxyphenyl (H) aromatic unit ratios, to study the impact of lignin composition on the chemical reactivity, enzymatic saccharification efficiency, and calorific value of rice lignocellulose. This study provides a foundation to identify a potent strategy for developing biorefinery-suited grass biomass feedstocks through molecular breeding approaches.

Keywords: Enzymatic saccharification, Heating value, Grass, Lignin, Lignocellulose

P101

Biosynthesis and Bioengineering of cell wall cross-linking ferulates in grasses

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Lignocellulosic biomass represents viable resources for sustainable production of biofuels and biochemicals. Of various plant feedstocks, grasses are especially important because of their superior lignocellulose productivity and processability. Further understanding of the elusive biosynthetic pathways of grass lignocellulose may contribute to improving our capability to enhance the production of grass lignocellulose and manipulate their structure and properties for better biomass utilizations through molecular breeding approaches. In this study, we explore biosynthesis and bioengineering of cell-wall-bound ferulates which are uniquely abundant proposed to serve as important cross-linkers between polysaccharides and lignin in grass cell walls. In particular, we focus on analysis of ALDEHYDE DEHYDROGENASE (ALDH) enzymes which are postulated to catalyze a key step in the biosynthesis of ferulate-associated metabolites in angiosperms. In this presentation, we report phylogeny and expression analyses of candidate ALDH genes in rice, a grass model species, and preliminary attempts to generate new ALDH-deficient rice mutant lines through CRISPR/Cas9-mediated targeted mutagenesis.

Keywords: Aldehyde dehydrogenase, Cell Wall, Ferulic acid, Grass, Lignocellulose

P102

Characterization of lignan *O*-methyltransferases involved in antitumor biosynthesis in *Anthriscus sylvestris*

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Lignans are phenylpropanoid dimers that are linked at C8-C8′ position of their propyl side chain, and are widely distributed in vascular plants. Lignan biosynthesis has been studied using several plant species, and some lignan biosynthetic pathways were proposed. Moreover, enzyme genes involved in lignan biosynthesis have been reported, and eight lignan *O*-methyltransferases (OMTs), catalyzing *O*-methylation of lignan, have been identified. Recently, our research group found four amino-acid residues, which are conserved among lignan OMTs, by comparative analysis of amino acid sequences of lignan OMTs. However, effects of these amino-acid residues on lignan OMT activity have not been examined.

In order to examine whether each amino acid residue affects lignan OMT activity or not, in this study, four mutant proteins of a lignan OMT, 5-*O*-methylthujaplicatin OMT, with single amino-acid residue substitution were prepared by site-detected mutagenesis. Then each mutant OMT was subjected to enzyme assay. As a result, the specific activity of two mutant proteins significantly decreased to 5.6−23.0% of that of original 5MTJOMT, suggesting that these two amino-acid residues might contribute to an expression of lignan OMT activity.

Keywords: lignan, *O*-methyltransferase

P103

Effects of Cutting Parameters on Space Distribution and morphological characters of airborne dust during MDF Milling

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Dust is one of the basic exposures and occupational hazard factors and exposure to wood dust may cause various diseases such as allergic rhinitis, chronic bronchitis, asthma and even cancer. Experiments show that Medium Density Fiberboard (MDF) creates up to six times as much dust as pine during milling. Moreover, the high amount and fineness of the dust produced from MDF and a potential risk of exposure to formaldehyde or other glue chemicals do a great harm to human health. In this paper, the effects of cutting parameters and corresponding cutting forces on dust mass and size number distribution in the working space when up-milling MDF were investigated and the morphological characters of the particles collected from different sample points were observed by image method. The results indicated that even the significant factor of dust emission amount is the average chip thickness not how the average chip thickness is obtained, the Spindle speed had a great influence on dust mass distribution in the working space. The dust with larger size had the opposite floating direction against the particles with smaller size. The inhalable fraction of dust (particles with aerodynamic equivalent diameter less than 10 μm) increased with increasing spindle speed and corresponding cutting forces in constant average chip thickness. Morphology analysis showed that the bigger particles exhibited more irregularity while the smaller ones presented more homogeneous shape. The results can be used in optimization programs for MDF milling machines to minimize the airborne dust generated and to reduce dust exposure.

Keywords: spindle speed, average chip thickness, cutting forces, dust distribution, morphological characters

P104

The Effect of Microwave on Lytic Polysaccharide Monooxygenases (LPMOs) Reaction

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Lytic Polysaccharide Monooxygenases (LPMOs) are copper-containing enzymes that oxidatively break down polysaccharides. Due to the high thermostability, LPMOs can be expected to own microwave-specific effect which was also called non- thermal effect. We compared the enzyme activity of LPMOs in the reaction with phosphoric acid swollen cellulose under oil bath and microwave heating. In order to eliminate the temperature difference between oil bath and microwave heating, the profile of the heating and cooling processes was adjusted to the same. The reaction was preformed by using both microwave and oil bath heating at 80 ℃ for 0.5, 1 and 2 h in contrast with the conventional reaction condition at 45 ℃ for 24 h. Under these conditions, The soluable carbonhydrates (27 μg/m) were detected by phenol-sulfate method from 183.56 μg/ml phosphoric acid swollen cellulose with 1 μg/ml LPMOs after 2 h microwave heating, which was higher than the oil bath. Furthermore, to confirm the microwave influences in the enzymatic reaction, the oligosaccharide model compounds such as cellopentaose were applied. We are aimimg to demonstrate the microwave effect by applying the experimental results to the Arrhneius equation kinetics.

Keywords: LPMO, Microwave effect, Cellulase, Cellulose

P105

Enhancement of Enzymatic Saccharification and Xylose Recovery of Wheat Straw by a Pretreatment Process using $MgCl_2$

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The pretreatment using acidic salt is a potential pretreatment method for bioethanol production, which mainly causes hemicellulose degradation. In the present work, the wheat straw was pretreated using $MgCl_2$ to improve the followed enzymatic saccharification process and recover the xylose from the pretreatment liquor. The results showed that the pretreatment using $MgCl_2$ mainly caused hemicellulose degradation, the removal rate of which was more than 95% in an optimized condition (0.2 mol/L $MgCl_2$ pretreated at 175 °C for 30 min), and the conversion yield of cellulose (CYC) in enzymatic saccharification process came up to 95.2%. Moreover, approximately 84.0% of the xylose could be recovered from the raw material, which obviously decreased the pretreatment cost. For the FTIR and XRD detection, it was found that the characteristic absorption peak of xylan had thorough disappeared from the raw material under an optimized pretreatment condition, correspondingly, the CrI of the raw material was also increased in a certain degree. The severity parameter (Log M_0) analysis was found that keeping the Log M0 at about 3.1 was beneficial for the enzymatic hydrolysis and xylose recovery.

Keywords: $MgCl_2$ pretreatment, Hemicellulose, Xylose recovery, Enzymatic saccharification

P106

Microscopic Assisting Spectral Analysis Visualized Chemical Changes at the Cellular Level during Pretreatment

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Through the bio-refinery process, the raw materials can be converted into fuels, power, heat, and a series of value-added platform chemical products. However, heterogeneity of lignocellulosic biomass cell walls contributes to the intrinsic recalcitrance of the biomass, impairing their practicability of bio-refinery. Thus, efficient pretreatments are requested for increasing efficiency of bioconversion. The research at the micro-region chemical alteration during a gradient of thermochemical pretreatment can provide theoretical guidance for the efficient bioconversion and utilization of biochemicals in the cell walls. *Arundo donax*, a fast-growing and widely cultivating Gramineae species in China, offers great potential in bio-refinery such as bioethanol production due to the huge yield. In this study, *A. donax* was subjected to 0.5% (w/w) sulfuric acid (H_2SO_4) for pretreatment at 140℃ for 10 min, 20 min, 40 min, and 60 min, respectively. Several spectroscopic and microscopic examinations were carried out to obtain the correlative structural and chemical information. Results from wet chemical and spectral analysis indicated that increasing reaction time could improve the removal of hemicellulose and lignin. The decrease of the cellulose content could be reflected by the gradual reduction of the birefringence. The fluorescence microscopy (FM) images and Raman spectrum visualized that lignin migrated from secondary wall to the compound middle lamellar during the pretreatment. These results indicated that the combination of spectroscopic and microscopic elucidation could give an insightful understanding of chemical changes at the cellular level during pretreatment.

Keywords: *Arundo donax*, lignin, autofluorescence, birefringence

P107

The Influences of Different Carbon Sources on the Surface Morphology and Structures of Synthetic Carbon Microspheres

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Due to the high specific surface area, chemical stability and electrical conductivity, the carbon microspheres revealed a promising perspective in adsorbent materials, catalyst carriers, electrode battery materials, et al. In this research, the carbon microspheres were synthesized via hydrothermal carbonization using natural biomass（*Eupatorium ade-nophora*）and saccharides (xylose, glucose and sucrose) as carbon sources. And the properties of different carbon microspheres were characterized by FE-SEM and ATR-FTIR to explore influence of the carbon source. In order to probe the differences between different carbon microspheres, the infrared spectra of 2000-800 cm^{-1} in the fingerprint characteristic region were analyzed by principal component analysis (PCA).
The results showed that the morphology and particle size distribution of carbon microspheres were closely related to the raw material. In terms of the chemical structure, no matter the complexity of carbon sources, the carbon microspheres all had aromatic ring structure and outer surface contained a high concentration of reactive oxygen groups, such as O-H, CHO. In addition, the PCA results showed the distribution of different carbon microspheres was relatively independent, there were obvious differences in the chemical composition of the synthetic carbon microspheres derived from different carbon sources. The results could provide a theoretical basis for further exploration and identification of the properties of carbon microspheres prepared by different carbon sources under hydrothermal conditions.

Keywords: Hydrothermal Carbonization, Saccharides, Biomass, Carbon Microsphere

P108

Simulation of GIC flowing through the power transmission network in Japan

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The energy released from the sun can enhance electric currents in Earth's magnetosphere, which induces an electric field on the ground surface. This electric field gives rise to geomagnetically induced current (GIC) flowing in a transmission line. Japan is situated at geomagnetically low latitudes, but the potential risk is probably non-zero because a large-amplitude of GIC, as high as 129 A, was recorded in the Japanese power in October 2003. To evaluate the potential risk of the Japanese power grid properly, we modeled the Japanese power grid with high voltage class over 187 kV. The uniform GIE imposed on the model was estimated on the basis of the geoelectric field observed in April 2018 at Kakioka Magnetic Observatory. The calculated GIC is roughly in agreement with that measured at 4 substations in Japan. For the westmost substation, a disagreement was found when we considered only the highest class of the power grid (500 kV), which may imply that the lower voltage class of the grid (<500 kV) may have some contribution to the GIC in Japan. We discuss the general tendency of the GIC flowing in the Japanese power grid, and prediction capability of the currently available model.

Keywords: Geomagnetically induced current (GIC), Geomagnetically induced electricfield (GIE), Solar wind, Magnetic storm, Power grid

P109

Calculation of Sound Insulation for Hybrid CLT Fabricated with Lumber and LVL and comparison with experimental data

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Recently, the concept of hybrid CLT (HCLT) has been demonstrated by replacing one or more layers of lumber with SCL, e.g. laminated strand lumber (LSL), to improve the planar shear and bending properties of CLT. Sound insulation has been investigated for a long time as one of the most crucial and interesting issue among the building environments. The wood sound insulation prediction was established by taking anatomical characteristics into account based on the derivation and verification of the transfer function. The simulated value was significantly related to the testing value at the level of 0.01, which verified the feasibility of prediction. Theoretical value of sound insulation was predicted by regarding the substances in wood cell wall as equivalence to specific medium, which explained the effect of wood microscopic characteristic on the mechanism of sound insulation performance. The bonding interface was creatively introduced to improve the accuracy of sound insulation prediction. It can clearly find that the sound insulation of HCLT is obviously higher than that of CLT by ignoring the material and the influence of test error. Therefore, it is very significance of the development of HCLT in the construction industry.

Keywords: Sound insulation simulation, equivalent medium, transfer function, wood microscopic characteristics

P110

Study on synergistic flame retardancy of wood treated with zirconium phosphate / ammonium polyphosphate

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In order to obtain flame retardant wood with good flame retardancy, strong thermal insulation and fast self-extinguishing. The flame retardant wood was prepared by layer-by-layer self-assembly method with simple process and low cost. The positively charged polyethyleneimine (PEI) was used as polycationic electrolyte and the negatively charged ammonium polyphosphate (APP) was used as polyanion electrolyte. Layer by layer assembled films were constructed on the surface of wood by electrostatic force. The intumescent $(PEI / APP)_n$ flame retardant wood with oxygen index up to 50.3% was obtained. A small amount of nanometer zirconium phosphate (ZrP) with layered structure is introduced as the physical barrier layer $(PEI / ZrP)_n$ of flame retardant expansion system, and the layer spacing of its own layered structure is used to reduce the combustion rate. Delay the diffusion of burning heat and oxygen to the wood surface, at the same time prevent the flammable volatile gas produced by the thermal decomposition of wood surface from spreading to the outside, and inhibit the pyrolysis of wood.The results showed that the flame retardant wood (PEI / ZrP+PEI / APP) with the inner expansion layer of the composite coating had better self-assembly film, the adsorption amount of N and P elements was more, the moisture absorption of wood decreased, and the oxygen index reached 42.5%.The combustion test shows that this type of carbon layer is thick, the structure of carbon layer is stable, and it is not easy to collapse. The comprehensive use of physical and chemical methods for flame retardant treatment of wood, not only play a synergistic role, but also reduce the amount of flame retardant, thus reducing the cost.

Keywords: Wood, flame retardant, layer by layer self-assembly, barrier expansion coating, zirconium phosphate

P111

The continuous production techniques of arbitrary length LVL for timber architectures

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This paper studied the continuous manufacture techniques of arbitrary length LVL for timber architectures based on thick poplar veneer by synthesis methods of veneer etheric modification, veneer finger joint lengthening technology and fabrication procedure, preparation of magnetic sensitivity adhesive, and radio-frequency curing process. The main research contents are as follows:
(1) Toughening and Reinforcing effect of impregnating process with 2D resin on surface poplar veneer were investigated.
(2) Influence of viscosity, solid content, electric field frequency and different additives of PF, MF and MUF resin to dielectric loss factors were compared and analyzed. The adhesive with high sensitivity to high frequency electric field and its modification process were obtained.
(3) Impact of veneer moisture content, adhesive viscosity, glue spread, electric field intensity and press time on the quality of adhesion was systematically studied and the model was established. The optimal high frequency hot pressing parameters were gained by optimizing the model.
The properties of poplar veneer LVL with arbitrary length and 20cm thickness prepared by the above process can meet the national standards of LVL for timber architectures.

Keywords: dielectric loss factor, poplar veneer surface enhancement, high-frequency pressing, veneer finger joint lengthening

P112

Design of WPC integrated architectural sketch in the park

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In today's society, science and technology are constantly improving by leaps and bounds, and the problems of energy shortage and gradual deterioration of ecological environment are becoming more and more serious. It has become the consensus of the whole society to protect the environment while maintaining its own rapid development. In the selection of building materials, renewable and environment-friendly materials have gradually become the object of people's favor. When wood is used in outdoor landscape, it is limited by its own performance, in order to make landscape architecture more beautiful and have better durability. The wood-plastic composite material which overcomes its defects has been widely used in landscape architecture. This paper points out the defects of wood materials in outdoor use and introduces the properties and application of wood - plastic composite materials. At the same time, combining the geographical conditions and ecological landscape of lovers' garden in nanjing, jiangsu province, several design schemes are put forward from the aspects of modeling, function, layout and scenery, so as to produce beautiful, close to nature and modern landscape architecture. The scheme reflects the advantages of WPC composite material in performance, aiming to broaden the idea for its application in the field of outdoor landscape, promote the development of landscape architecture, and drive the market demand.

P113

Aesthetic Utilization and Processing Technology of Natural Bending Wood

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Natural bending wood is a kind of defective wood formed by the influence of physiological process, genetic factors or growth environment in the growth process of trees. In the field of wood processing, the utilization value of the bending wood is low, with low yield, difficult processing and easy deformation. However, bending wood has mild and fresh color, natural wood surface lines and smooth shape curve, which has important aesthetic value. Bending wood is convenient for tailor-made design and adapts to the decorative application requirements of different styles of buildings. This paper analyses the aesthetic value of natural bending wood, probes into the bending processing and installation technology, and puts forward the application prospect of natural bending wood, which has important guiding significance for the Value-added Utilization of natural bending wood.

Keywords: Natural bending wood, Aesthetic Utilization, Processing and Installation

P114

Effect of alkaline pretreat on poplar veneer for bonding performance of scrimber

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Scrimbers is generally processed by impregnating adhesive. Therefore, the Wettability of veneer is a key factor affecting the infiltration of adhesives and the physical and mechanical properties of scrimbers. The pH value of veneer is an important factor affecting the performance of impregnation or coating. Therefore, this paper studied the influence of pretreatment conditions of pH value of poplar veneer on the bonding performance of scrimbers. The NaOH with pH value of 9.0 was used to pretreat the heartwood and sapwood of poplar veneer, and then the modified wood was hot-pressed after impregnating with phenolic resin. The wettability of pretreated poplar veneer was characterized by contact Angle, and the bonding performance of pretreated poplar veneer was tested by fluorescence microscope and mechanical testing. The results showed that the main functional groups of poplar veneer did not change obviously after alkali treatment. Fluorescence microscopy revealed that the bondline morphology of treated FFPV scrimbers changed significantly, with a thinner bondline, deeper penetration distance and smaller glue stain. The short-beam shear strength of the scrimber is positively correlated with the permeability of the adhesive.

Keywords: Alkaline treatment, poplar veneer, microstructure, Bonding interface

P115

Evaluation of the Out-of-Plane Shear Properties of Cross-Laminated Timber

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The out-of-plane shear properties of cross-laminated timber (CLT) substantially influence the overall mechanical properties of CLT. Various testing methods and theories related to these properties have recently been developed. The effects of the number of layers (three and five layers) and testing method (short span three- and four-point bending tests) on the out-of-plane shear properties of CLT were evaluated. The out-of-plane shear strength values were calculated based on different theories for comparison. The failure mode in the short-span four-point bending (FPB) method was mainly the rolling shear (RS) failure in the cross layers, indicating that the FPB method was appropriate to evaluate the RS strength of CLT. The out-of-plane shear capacity obtained using the three-point bending (TPB) method was higher than that tested by the FPB method. The testing methods significantly influenced the out-of-plane shear capacity of the three-layer specimens but not that of the five-layer specimens. With an increase in the number of layers, the out-of-plane shear strength of the specimens decreased by 24%. A linear correlation was found among the shear strength values obtained from different theories.

Keywords: Cross-laminated timber, out-of-plane shear properties, testing methods, failure modes

P116

Study on Milling Properties of Faced Particle Board

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In recent years, with the rapid development of China's wood furniture industry, various wood-based panel processing industries have been greatly promoted. The facing particleboard is widely used because of its high surface hardness, strong wear resistance and beautiful appearance. However, due to the immaturity of the current processing technology and the special structure of the facing particleboard itself, the edge of the finishing process is easily caused to be rough in the milling process, and the wear-resistant layer of the facing surface is collapsed, which greatly increases the repairing workload after the edge sealing. , reducing the continuity of the production process and the quality of the product.

The research in this paper mainly studies the processing performance when milling the facing particleboard. By adjusting the milling parameters, the relationship between the milling parameters and the surface quality of the facing particleboard, and the relationship between the surface quality and the cutting force are investigated. Explore more excellent and efficient processing and production processes.

In this experiment, the orthogonal analysis method was used to analyze the main parameters of the influence of the surface roughness of the milled facing particleboard:

1. The material of the cutter body, the spindle speed and the milling depth all have different effects on the surface roughness. The most influential factor is the spindle speed;

2. Then through the specific accurate measurement and analysis of the three parameters of the surface roughness, chipping and chip shape of the facing particleboard under different parameters, find out which one or several factors can obtain a better finish. Particleboard surface quality.

Keywords: Faced particle board, Diamond cutter, Hard alloy cutter, milling, Surface roughness

P117

Research and Simulation Analysis of Thermal Performance and Hygrothermal behavior of Timber-Framed Walls with different heat preservation layer

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In order to improve the comfort of the living environment, the thermal performance of the exterior walls of two timber-framed structure buildings is theoretically calculated and experimentally studied in this study. Both of the two buildings are located in Nanjing, the hot-summer and cold-winter zone. Then WUFI is used to simulate and predict the changes of temperature, relative humidity and water content of the two timber-framed structure buildings, to strengthen the theoretical analysis of the thermal and humidity coupling of the external walls, and to propose an optimal design scheme for the insulation and temperature and humidity regulation of the external walls. The main results show that the tested thermal conductivity is basically consistent with the predicted value, which prove that WUFI simulation can effectively predict the heat preservation performance of the external wall. The two timber-framed structure buildings are both suitable for the cold areas, and the reasonable optimization of the design of the structure is the key to the insulation of the building wall. Timber-framed structure is proved to have good temperature-humidity regulation effect. The moisture content of the two timber-framed structure buildings is stable and the annual temperature and winter humidity are within the appropriate humidity range.

Keywords: Timber-framed structure, Exterior wall, Parametric study, Hygrothermal performance, WUFI simulation

P118

Rolling shear properties of fast-grown eucalyptus laminations

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The goal of this investigation was to evaluate the effect of aspect radios on rolling shear strength properties of cross-laminated timber, fabricating with eucalyptus. Digital image correlation and finite element method were used in this study. The results indicated that rolling shear modulus and strength increased as the aspect ratio increased. The properties of CLT made of eucalyptus were greater than that of SPF. It proved the feasibility to fabricate CLT with eucalyptus. The strain distribution maps achieved by DIC and FE were similar, which demonstrated the accuracy of DIC. The only shortcoming was the failure of analyzing the strain around gaps and edges. Two possible reasons accounted for this shortcoming. First, DIC couldn't analyze the zone where was gap. Second, the zone is too narrow to capture. Next step, we will try to decrease the step and filter size for the following experiments to verify whether DIC could be so accurate to analyze the narrow area. The main damage of eucalyptus specimens almost happened at the geometric center having the unbonded gap, along the annual ring or wood ray. And the destruction process of the test piece with the aspect ratio of 2 is relatively fierce.

Keywords: Rolling shear, Finite element analysis, Digital image correlation

P119

Vibration test and comfort analysis of wood diaphragm environment and impact excitation

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In order to meet people's objective requirements for the comfort of wood structure construction, the environmental excitation method and impact excitation method were used to carry out for six measuring points of the floor structure of a two-story light-wood structure residential building. The basic frequency test of floor structure under environmental excitation together with the ball excitation dynamic vibration test of single and rhythmic movement of basketball and tennis under impact excitation were carried out, as well as dynamic vibration test of jump, single-step, steady walk and rhythmic running. The comfort analysis of the building is based on the test results of fundamental frequency, peak acceleration, peak velocity and effective value. The research shows that the measured fundamental frequency values of the environmental excitation and impact excitation methods of the floor structure are higher than 4.5 Hz, which meets the comfort requirements. The maximum value of the measured peak acceleration under the impact excitation mode is 407.2 mm/s^2, which is between being felt obvious and uncomfortable. The maximum peak velocity value is 5.606m/s, which meets the building comfort requirements. The maximum value of the acceleration effective value (RMS) is less than $0.45m/s^2$, which meets the building comfort requirements. Comprehensively evaluated, the floor structure meets the comfort requirements. The above-mentioned research is engineeringly applicable to promote the vibration characteristics of the domestic fabricated wood diaphragm and to optimize the building comfort.

P120

The effect of compression on the dynamic strain distribution of OSB

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Oriented strand board (OSB) is an important engineered wood product and commonly used as sheathing in walls, flooring, and roof decking. Water sorption can cause its internal structural changes and mechanical strength decrease. It is essential to understand the effect of water sorption/desorption process on mechanical performance of OSB. Deflection of two types of OSB was studied when they were exposed in cyclic loading and water sorption/desorption conditions. Deflection and strain distribution along panel thickness direction were continuously recorded with digital image correlation (DIC) method during three point loading test. The results shown that residual deflection mainly occur in the first cycle. Water sorption/desorption can linearly enlarge deflection of the specimens. Both large deflection and strain are prone to occur in region 1-3mm away from the top surface. Large strain induced with water sorption/desorption process can transform from top to bottom surfaces of the specimens. Strain accumulation is an important factor of decreasing loading capacity of OSB under loading and water sorption/desorption process. In addition to the region adjacent to the top surface, strain accumulation could occur in region with structural defects. Promising strain transformation from top to bottom and avoiding the structural defects are helpful for diminishing the impact of water sorption/desorption process on loading capacity of OSB. The results of this study can provide OSB structural designers and technologist with information regarding to the water resistant panels.

P121

The effect of structural changes on the compressive strength of LVL

Zheng Zhang

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Laminated veneer lumber (LVL) is an important engineered wood product manufactured by bonding veneers together. It is crucial to investigate the interaction between internal structural changes and mechanical performance of LVL. Three types of LVL with different assembling approaches, namely loose-loose (LL), tight-tight (TT) and loose-tight (LT), are manufactured. Compressive strength of the samples is measured, during which the internal structural changes are recorded using X-ray CT. The results show that the compressive strength of LT is significantly higher than that of TT and LL types of LVL. During the compressive test, grey scale value increase in the samples is non-homogenous. Grey scale value increase in glue line is slight, and in the regions with low grey scale value is large. Grey scale value increase is mainly induced by the structural changes, such as the squeeze of the large vessels. Existence of resin can protect vessels from structural changes. Structural changes are likely to occur in the regions with big structural differences, for instance the boundary between small and large vessels. Ruptures, induced from the squeeze of the large vessels, are easy to be generated in regions where the large vessels are contiguous. Findings of this study can contribute to the designing potential strategies to increase the compressive strength of LVL and other wood-based panels in a more effective way.

P122

Experimental investigation of sheathing connections in wood shear wall with ply-bamboo sheathing panels

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Common nails were unsuitable for the sheathing connections in wood shear wall with ply-bamboo sheathing panels, due to low connection strength and driven difficulty. This paper adopted self-tapping screws as the connectors of eight groups of sheathing connections. Monotonic loading tests were conducted to investigate the influence of different variables on the lateral behavior of sheathing connections. The variables in terms of sheathing material, sheathing thickness, screw edge-distance and loading direction were considered. Test results indicate that the usage of ply-bamboo panel in sheathing connections can effectively avoid the failure of nail-head pulling through, resulting in a significant increase of ultimate bearing capacity. The screwed ply-bamboo sheathing connections loaded perpendicular to the framing grain behaved slightly higher ultimate strength but lower ductility than those loaded parallel to the framing grain. The increase of ply-bamboo sheathing thickness and screw edge-distance had little effect on the behavior of screwed ply-bamboo panel sheathing connections. The initial stiffness and ultimate strength of screwed ply-bamboo sheathing connections were 4 to 5 times higher than those of the connections fabricated with common nails, indicating that the usage of screws can significantly improve the lateral performance of wood shear wall with ply-bamboo sheathing panels.

Keywords: ply-bamboo panel, self-tapping screw, sheathing connection, monotonic loading, ultimate bearing capacity

P123

Design and Research of C-type Wood Thin-Walled Structure in Building

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This study designed the cross-sectional shape of C-type wood thin-walled structural materials, presented a mold for its manufacturing, analyzed the bending mechanical behavior of it, and researched its preparation process. Also the dimensional stability, gluing properties and bending resistance were tested. The results were:
1)The bending of a C-type wood thin-walled structure is generally asymmetric bending which means a beam bending without a symmetry plane. The calculation of it is based on the imaginary plane. 2)The cross-section of C-type wood thin-walled structure is mainly with a curling structure, and the combination of C-type wood thin-walled structure can be divided into two methods: parallel lay-up of Laminated Veneer Lumber and criss-cross in lay-up of Plywood. 3)C-type wood thin-walled structure is accompanied by elastic deformation during hot pressing. The amount of spring-back largely depends on the shape and internal stress distribution of C-type wood thin-walled structure before spring-back. 4)The maximum load of C-type wood thin-walled structure of plywood is greater than that of LVL. The maximum load in the flange direction of opening upward and opening downward is little different, and in the Web direction is the smallest. The C-type wood thin-walled structure has a wide section, light self weight, good mechanical properties and flexibility, can effectively use resources and save costs, thus conforming to the concept of building environmental protection.

Keywords: C-type wood thin-walled structure, bending, deformation, gluing

P124

Cyclic Loading Test of 3-story CLT Structures

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For the sake of promoting cross laminated timber (CLT) structure, Japanese government notifications (GN) on the structural design of CLT panel buildings and definition of standard strength of CLT were issued on 2016. Following the issue of the GN, the guidebook on the regulations of the GN and the manual on design and construction of CLT panel buildings were published on Jun. and Oct. 2016 respectively. In the GN and manual, three kinds of CLT structures were classified. This paper introduced the research on balloon framing CLT structure, which was not covered by GN. Compared with platform framing structure, which was clarified in GN, balloon framing structure has superiority in shortening the construction period and reducing the amount of CLT panels and metal connectors. Aiming to provide more options for GN, the seismic property of balloon framing CLT structure was studied. static cyclic loading tests were carried on four kinds of 3-storey CLT structures: ① platform framing with small size shear walls; ② balloon framing with continuous shear walls; ③ platform framing with broad panels; ④ balloon framing with continuous shear walls coupled with glulam beams.

Keywords: CLT, seismic properties, balloon framing, platform framing

P125

A New Production Mode Of Plate Furniture

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This abstract takes a company in Anhui province as the object of study, adopts the method of combining theory and practice, systematically studies the digital design technology of plate furniture, and obtains the following results:

1.The disadvantages of the traditional mode of plate furniture were analyzed comprehensively.
2.Use digital design technology to solve the problems of traditional business model, and analyze the necessary preparation and selection of digital construction.
3.Direct use of standardized design concept, respectively on the company's representative product parametric design specifications and series, modular design.
4.Using WOOD CAD/CAM (WCC), a special software for panel furniture design and production, to conduct 3d modeling and develop databases from materials, hardware to products.
5.The electronic document management system is designed and developed by using the database, and ensured the security, effectiveness and rapid sharing of documents.

The whole production process of digital manufacturing guarantees the utilization rate of wood to the greatest extent and reduces the waste of production capacity in the production process of furniture. This is a kind of innovation and contributes to the sustainable circle of human beings.

Keywords: panel furniture, Digital technology, parametrization design, electronic document management

P126

Partial compression strength of Glulam against CLT Loading

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Cross Laminated Timber (CLT), a new generation of engineered wood-based products, provides promising solution to the mid- and high-rise wood building. When CLT panel is constructed as a wall, a huge vertical load transferred from CLT wall may cause a significant partial compression problem on the horizontal component like Glulam floor. Thus, the structural performance of Glulam, specially the strength and stiffness of Glulam, against CLT partial loading become very important for structural design. In this case two compression directions with two CLT products was investigated in this paper. All the Glulam and CLT products are in same size and Glulam was compressed at the central of the top surface. Steel plate compression was set as control group. From the result, the effective strength of CLT compression, $f_{c,90,eff}$, is 1.3~2.0 times higher than the strength compressed by steel. DIC analyze result shows that the stress is more concentrated in steel compression. The differences of load supporting layer inside glulam between steel and CLT compression need to be investigated in further study.

Keywords: Partial compression, CLT, Strength

P127

Flexible Performance Evaluation of Flatten Bamboo Veneer Plybamboo Reinforced by Carbon-fiber Fabric

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To improve the product quality of traditional plybamboo and utilize the resources of bamboo, Carbon-fiber fabric (CF fabric) reinforced composite plybamboo were prepared by using flatten bamboo veneer as base materials and CF fabric as reinforcement material. Three-lay vertical composite structures and two reinforcement positions (control group, surface group and core group) were considered in this study, and the flexible performance of plybamboo were tested and evaluated. Experimental results showed that the flexible performance of surface enhancement group was better than core layer enhancement group. The plybamboo strengthened by the surface and core simultaneously had better performance and three groups satisfie the strength requirements of building floor.

Keywords: Building floor, CF fabric, Plybamboo, Composites

P128

Research on the physical and mechanical properties of 'zhongshansha 302' laminated veneer lumber reinforced by Phenol Formaldehyde Resin

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'zhongshansha 302' is an excellent fast growing tree species, which has a low modulus of elasticity. In order to improve the application of this tree species on wood-based panel, the physical and mechanical properties of phenol formaldehyde resin reinforced LVL (Laminated veneer lumber) was analyzed. In this paper, the untreated veneer and phenol formaldehyde resin reinforced veneer was composited with different lamination structure to manufacture LVL. And then the physical and mechanical properties were preliminarily studied according the standard of GB/T20241-2006. Results indicated that: phenol formaldehyde resin penetrated into the wood through pore structures and strengthen the veneer. The mechanical properties of laminated veneer lumber with the composite structure (the top and the bottom layers were laminated with PF reinforced veneer or the top, bottom, and core layers were laminated with PF reinforced veneer) were obviously improved. After the enhancement treatment, the modulus of rupture (MOR) and the horizontal shear strength of the laminated veneer lumber met the national standard for structure, respectively. And the modulus of elasticity had been improved to meet the requirements of the national standard for non-structural laminated veneer lumber.

Keywords: 'zhongshansha 302', laminated veneer lumber, physical and mechanical properties, resin impregnation

P129

Study on adaptive clutter rejection system using external receiving antennas for the MU radar

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Strong clutter echoes from a hard target such as a mountain or building sometimes cause problems of observations with atmospheric radars. In order to suppress ground clutter echoes, it is effective to use NC-DCMP (Norm Constrained- Directionally Constrained Minimum Power) method, which makes null toward the direction of the clutter, if we can receive signals independently from plural antennas. Although NC-DCMP method suppresses clutter echoes with almost maintaining the shape of main lobe to add pseudo-noise compared with the conventional DCMP method, the signal-to-noise ratio (S/N) of atmospheric echoes is somewhat degraded. We studied the clutter suppression method with little S/N degradation by using external antennas.
Four turnstile antennas are installed in the MU radar site. We compared the NC-DCMP method using the each received data of 25 channels, which is a conventional clutter suppression method, and the NC-DCMP method using the simple combination of 25 channels and 4 channels of external antennas. In the former case, the S/N of the atmospheric echoes is somewhat degraded, but in the latter case the main lobe shape is guaranteed by 25 channel simple synthesis, so the S/N degradation is not observed. In the latter case, the clutter suppression is sometimes insufficient. This cause is considered to be that the current positions of external antennas are biased to the north side. Antenna positions should be optimized in the future.

Keywords: Atmospheric radar, Clutter rejection, NC-DCMP method, MU radar

P130

Effect of polyelectrolyte ammonium polyphosphate on the flame retardancy and mechanical properties of wood fiber-polyethylene composites

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In this study, polyelectrolyte APP was prepared by APP treated with NaCl, PEI (polyethyleneimine) or acid-base titration method. Transmission electron microscope (TEM) and fourier transform infrared spectroscopy (FT-IR) test were used to analysis it’s morphology and structure. Then polyelectrolyte APP was added to wood plastic composite (WPC), limiting oxygen index (LOI), thermogravimetric analysis (TG) and mechanical properties tests were applied to analysis the flame retardancy and mechanical properties of WPC. Results indicates that during modification process, the size of APP decreased significantly and shows a better dispersity. The thermal degradation process of polyelectrolyte APP changes significantly as the initial decomposition temperature and the maximum decomposition temperature are all in advance. After the addition of APP polyelectrolyte, the LOI of WPC is improved. The LOI of WPC/t1-APP 15%, WPC/n-APP 15%, WPC/p-APP 15% are 24.9%, 24.7% and 24.8%, respectively. WPC/p-APP 15% shows the best combination properties improvement, it shows a mechanical performance compounding with a tensile strength of 19.48 MPa, impact strength of 7.72 kJ/m2, tensile elongation at break of 13.85% and tensile modulus of 4853.22 MPa, increased by 18.2%, 15.9%, 39.7% and 57.0% compared with that of WPC/APP 15%. The flame retardant and toughening properties of WPC can be improved simultaneously by using APP polyelectrolyte prepared by PEI.

Keywords: polyelectrolyte, ammonium polyphosphate, WPC, toughening, flame retardancy

P131

Characterization of Phenol Resin Based Porous Activated Carbon Microsphere as Supercapacitors electrodes

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Phenol resin (PF) were easily synthesized by hydrothermal method in a metal reactor followed carbonization and activation to prepare porous activated carbon microspheres (ACMs). The scanning electron microscope (SEM), Fourier-transform infrared resolution (FT-IR), nitrogen desorption and adsorption and electrochemical workstation (3-electrode test) were used to characterize its performance. The results showed that the optimal preparation process of ACMs was: 250°C, 5h. The diameter of microspheres is 1-3 μm, uniform size, high surface area is 2528 m^2g^{-1}, good dispersion and partial graphitization structure, which give the ACMs high electrochemical properties. ACMs showed the obvious effect of electric double layer, the contact resistance is 0.046 Ω, specific capacitance of 24 F/g, the cyclic retention rate is 73% (0.5A/g-10 A/g).

Keywords: Hierarchical morphology, phenol-formaldehyde resin, Hydrothermal method, Electrochemical properties

P132

Study on light transmittance of Dragon's blood wood and anatomical structure comparison between Dragon's blood wood and *Pinus* sp.

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Dragon's blood wood belongs to *agathis* (araucariaceae), Due to its high resin content and the pattern on the wall of the tracheid, the Dragon's blood wood has a certain light transmittance, furthermore, the absorption of the wood to the medium and short wave long light, hence, it can only pass through a longer wavelength of red light. In addition, there is another kind of *Pinus* sp. (Pinus sect.) is have high resin content and good transmittance. From the anatomical structure of the Dragon's blood wood and *Pinus* sp., the final results, there are obvious differences between the two structures, such as the growth wheel, the density, the grain hole, the cross field and the wood rays.

Keywords: Dragon's blood wood, light transmittance, *Piuns* sp., anatomical structure, resin

P133

High-pressure steam: A facile strategy for the scalable fabrication of flattened bamboo biomass

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Bamboo features the fastest growing speed and abundant in the plant kingdom.However,it remains a huge challenge to prepare large flat surface boards by directly sawing or cutting due to the hollow cylindrical shape of bamboo culms. We herein have demonstrated the preparation of facile scalabe fabrication of larger flattened bamboo board without cutting it into arcs bamboo strips by high-press steam softening approach. The results show that modulus of elasticty (MOE) of bamboo decreases with increasing softening temperature from 100℃ to 160℃,and increases 8.3% from 160℃ to 180℃. In addition, the main components of bamboo have no obvious changes when the softening temperature is below 140 °C. Moreover, the density and MOE are reduced after softening due to the decomposition of chemical components and increases after flattening due to increasingdensification of bamboo which makes the flattened bamboo structure more uniform and stable. Hemicellulosestarts to decompose from 160 °C and the equilibrium moisture content (EMC) of soften bamboo is similar with flattened bamboo. It is also found that the volumetric swelling of the flattened bamboo is higher than that of soften bamboo. This work offers a facile methodology for promoting the high value-add utilization of bamboo biomass, and obtaining larger flatten bamboo board with high performance at a treatment condition of 160℃and 8 min.

Keywords: Bamboo, MOE, EMC, High-pressure steam

P134

Application of high temperature sterilization in bamboo mould research

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In recent years, the shortage of wood resources, search for new wood substitute resources, research and extension of the application of new technology, wood production and processing industry is an important topic. Therefore, bamboo with fast growth and high yield has been widely used, and the research on bamboo has been paid more and more attention. However, due to the fact that bamboo contains more nutrients than wood, it is easy to be mildewed when stored and used in an appropriate temperature condition, which not only limits the application field, but also causes great waste of resources and economic losses. Therefore, it is particularly important to study the mildew-proof treatment of bamboo. In anti-mold technology mainly divided into physical treatment methods and chemical methods, each method has its own principle and operation, such as physical treatment method of high temperature sterilization, used in a petri dish, make good on the culture medium, by high temperature, ultraviolet disinfection sterilization, aspergillus Niger, green trichoderma viride, orange penicillium mold received has made a good medium, then treated with different process of bamboo culture dish that is put in the long has good mold to observe the mildew of bamboo. The resistance of bamboo treated with different technology to different mould was tested by observing the mildewed area of bamboo.

Keywords: shortage of wood resources, bamboo, mildewed, high temperature sterilization

P135

Effect of saturated steam treatment on the chemical composition and crystallinity properties of bamboo bundles

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"Replacing wood with bamboo" has become an effective way to alleviate the pressure of material shortage in wood processing industry. In recent years, bamboo-based composites have been widely recognized by the society and developed quickly. Using saturated steam instead of air and oil as heat transfer medium can not only efficiently realize the heat treatment of bamboo-based materials, but also effectively improve their corresponding physical and mechanical properties, and further construct an environment-friendly heat treatment method to reduce the corresponding pollutions. However, little research has been done on this method, especially on the variation of the chemical composition and crystallinity properties of bamboo bundles during the saturated steam treatment. In this work, the effects of initial moisture content and heat treatment time on chemical composition and crystallinity of bamboo bundles were studied by FTIR and XRD. The results showed that the effect of initial moisture content on the crystallinity of cellulose mainly occurred during the period from drying to 20% moisture content change. The corresponding crystallinity decreased rapidly from 0.62 to 0.50, and then the crystallinity of bamboo bundles remained unchanged at ~0.48 when further increasing the corresponding initial moisture content. Furthermore, the saturated steam heat treatment enlarges the crystal layer distance and the particle size of the contained cellulose in crystallization zone. This is mainly due to the macro residual stress in the cellulose of bamboo bundles caused by saturated steam heat treatment, which results in lattice distortion and then makes the lattice anisotropic shrinkage. In addition, with the prolongation of heat treatment time, the content of lignin gradually increased with the decrease of hemicellulose. After 50 minutes of treatment, the content of hemicellulose decreased by 71.8%, 68.6%, 84.4%, 52.2% and 87.1% for the bamboo bundles with the corresponding initial moisture content increasing from 10% to 80%, respectively. And the content of cellulose increased and then decreased, reaching the maximum in 30-40 minutes. This is mainly due to the thermal degradation of hemicellulose, producing a large amount of acetic acid at the beginning of the heat treatment reaction which catalyzes the degradation of cellulose in the amorphous zone in acidic environment. After that, with the increase of heat treatment time, the degradation of hemicellulose in bamboo bundles became more and more intense, resulting in the increase of the relative content of cellulose.

Keywords: bamboo bundles, reconstituted bamboo, saturated steam heat treatment, crystallinity, chemical composition

P136

Processing densified bamboo from bulk attacked by Aspergillus Niger

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Bamboo is a natural biological material, which is eco-friendly and renewable. And it has become a structural material for construction and building industry because of its excellent properties such as tensile strength. It is true that the demands for low-cost structural materials with light weight and high strength have become more urgent with the continuous development of aviation, construction and other fields. However, compared with steel and other high polymer materials, the mechanical performance of bamboo (its strength and toughness) is not unsatisfied. In order to improve the strength of the bamboo, this research adopts Aspergillus Niger to pretreat Phyllostachys pubescens Mazeland and then densifies the treated bamboo bulk into a new high-performance material. This biological treatment method avoids chemical pollution and is environmentally friendly. Densified bamboo could replace the steel and aluminum alloy to become a new material with high strength and light weight.

Keywords: bamboo, Aspergillus Niger, densification, mechanical performance

P137

Roles of extracellular metabolites produced by selective white-rot fungi

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Conversion and utilization of plant biomass resources are essential for a sustainable future. Lignin is a hard-to-decompose aromatic polymer with a rigid structure. In nature, white-rot fungi have the ability to degrade lignin. The white-rot fungus, *Ceriporiopsis subvermispora*, degrades lignin in preference to cellulose. We have demonstrated that secreted extracellular metabolites have critical roles in lignin degradation in addition to lignin-degrading enzymes. Ceriporic acids (CAs) have been shown to attenuate cellulose degradation by inhibiting the Fenton reaction. We also demonstrated an effective lignin degradation reaction with a combination of CAs and manganese peroxidase. However, little is known about the mass transfer of enzymes, metabolites, and lignin decomposed fragments, between the mycelium and substrates. Recently, extracellular vesicles (EVs) secreted outside the hyphae have been reported in basidiomycetes. We investigated EVs in selective white-rot fungi and now trying to study their relationship with lignin degradation.

Keywords: Plant biomass, Wood, Lignin, White-rot fungi, Metabolites

P138

Study on the influence of saturated steam heat treatment on the color of bamboo

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In order to study the response of bamboo color to different heat treatment time and initial moisture content during saturated steam heat treatment, the influence of saturated steam heat treatment process on the color characteristics of bamboo was determined.In this paper, bamboo slices were taken as the research object. Saturated steam at 180 ° c was used for heat treatment of bamboo slices. After that, the color changes of bamboo slices with different initial moisture content (25%, 30%, 40%, 50% and 60%) after different heat treatment times were quantitatively tested, and CIE L*, a*, b* standard chroma system was used for systematic analysis.The results showed that the initial moisture content and heat treatment time of bamboo had a great influence on a*, b* and L*, in which a* value first increased and then decreased, indicating that the bamboo treated material was red, while the yellow and blue axis color index b* and lightness value L* showed a trend of decrease, indicating that the bamboo treated material was blue and dark.With the decrease of bamboo brightness, the value of a* changes in a trend similar to parabola, while the value of b* mainly shows a trend of linear decrease, but both of them are greater than 0.The distribution range of L* and b* values between bamboo materials with different initial moisture content is not significant, while the variation range of a* values is somewhat different.Under the condition of the same initial moisture content, heat treatment time on the bamboo overall color difference (Δ E *) mainly focused on the influence of the 10 ~ 20 min, and Δ E * by the brightness difference (Δ L *) is larger, the influence of product difference and yellow and blue (Δ b *) affect Δ E * than red and green product difference (Δ a *).In addition, the color saturation C* and saturation difference ΔC_ab^* of the treated bamboo decrease with the increase of heat treatment time, while the color variation ΔC* is just the opposite.

Keywords: bamboo, color, saturated steam heat treatment, CIE

P139

Artificial lignified cell wall synthesis in imitation of wood formation process

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We challenged to produce lignified cell wall in vitro followed the multi steps along the actual formation in nature. It is generally accepted that woody cell wall formation requires three steps: First, cellulose microfibrils are biosynthesized and accumulated in the cell wall by cellulose synthases after which non-cellulosic polysaccharides including hemicellulose are transferred to the microfibrils. Second, peroxidases are delivered near the hemicelluloses on the microfibril surface. Lastly, lignin is polymerized from the monolignols which were catalyzed by peroxidases that placed within the hemicelluloses. We successfully synthesized artificial woody cell wall following synthesizing process in trees: First, polysaccharide networks consisting of cellulose and hemicellulose as a scaffold, are constructed. Second, peroxidases are localized near the hemicelluloses by using antigen-antibody reaction. Finally, artificial lignin is synthesized using the enzymes by feeding monolignols. In the presentation, we would talk about the products obtained at each step chemically and morphologically characterized by Fourier transform infrared (FTIR) spectroscopy and/or TEM observation.

Keywords: Cell wall, cellulose, hemicellulose, lignin, immunoreaction

P140

Development of "white-colored wood" prepared from hardwood and its characterization

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Hardwood block without matrix components such as lignin and hemicellulose has been successfully created by two-step chemical processing with keeping the woody hierarchical structure. By monitoring FTIR spectra, alcoholysis condition of initial step was optimized. After alcoholysis, a repetition of wise treatment proceeded delignification form skin to core of wood block, and completely white-colored wood block was prepared. In order to confirm the wood hierarchical structure from anatomical- to nano-level, multiple assessments were carried out. First, X-ray computed tomography (CT) was applied to observe the anatomical structure, which revealed that the natural cell arrangement was unaltered. Next, we recorded an X-ray diffraction diagram which indicated to maintain the microfibril orientation in the cell wall and natural crystalline structure. Finally, cellulose nanofiber was prepared using a TEMPO-mediated oxidation technique to observe the microfibril morphology. TEM image revealed that the typical shape of cellulose microfibrils was maintained, although they partially showed fragmentation because of a harsh chemical treatment. Given the abovementioned optimal chemical treatment and structural characterization, we successfully developed a lignin-free wood block while preserving its hierarchical structure.

Keywords: Hardwood, cellulose, delignification, hierarchical structure

P141

Characterization of different cellulose microfibrils after acid hydrolysis with special attention to longitudinal suprastructure

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Longitudinal disordered regions in higher plant microfibrils have been investigated by using cellulose from various origins under never-dried or oven-dried condition. Large cross-sectional microfibrils of tunicate and spirogyra that is fresh water algae, could maintain long length even after harsh treatment such as high concentration of sulfuric acid regardless of dehydrated condition. When callus cellulose derived from Japanese cedar was prepared without drying, microfibrils maintained long length even after strong acid hydrolysis. However, the microfibril length of cellulose after oven-drying followed by acid hydrolysis was around 150 nm with narrow length distribution, corresponding to leveling-off degree of polymerization (LODP). Principal component analysis, a kind of multivariate analysis, was performed based on the length distribution of microfibrils from different origins. The microfibrils from tunicate and spirogyra were unaltered without relation to drying condition. Interestingly, cellulose microfibrils extracted callus after drying was moved to the group of terrestrial plants after acid hydrolysis, which clearly indicated that longitudinal crystalline defects were therefore induced by dehydration. In the presentation, we will discuss longitudinal suprastructure from buckwheat seedling in terms of microfibril bundle.

Keywords: microfibril length, LODP, acid hydrolysis

P142

Preparation and properties of wood fiber transparent composite

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There are a lot of cellulose in wood, which has high strength and excellent optical transmittance. The transparent material can be obtained by compounding with polymer. However, restricted by the permeability of wood, the size of transparent wood is difficult to meet the needs of practical engineering applications. In this paper, the wood is broken and delignified, and further dispersed to obtain lignocellulose. This can break through the limit of permeability to the greatest extent. The wood cellulose was permeated with pre polymerized methyl methacrylate and then heated up to further polymerize. It can be made into wood fiber PMMA transparent composite material of any size. The results show that the wood fiber transparent composite has excellent optical properties, thermal properties and mechanical properties, and has great application potential in the field of energy conservation and environmental protection as well as in the field of building materials.

Keywords: Wood fiber, transparent, PMMA, optical properties, mechanical properties

P143

Effect of initial moisture content of thin veneers on melamine formaldehyde resin impregnation

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Resin-impregnated thin veneers were fabricated using poplar, pine, and Bingtangor thin veneers as raw materials with melamine formaldehyde (MF) resin. The effect of initial moisture content (MC) of the veneers on the surface morphology, content of impregnated resin, degree of pre-curing, and content of volatile substances of the impregnated veneers were investigated. As well, the bond strength of impregnated veneers on fiberboard was tested. The results showed that, with the same impregnation process, higher moisture content (from zero to 30%, based on ovendry weight of thin veneers) brought decreased content of MF resin and degree of pre-curing, while higher content of volatile substances. Simultaneously, the overlaying bond strength was first increased and then decreased. It's suggested that MC of thin veneers be controlled among 10 to 20% to ensure strong overlaying performance.

Keywords: thin veneer, moisture content, melamine formaldehyde resin, impregnation

P144

UZnCl$_2$-DES assisted synthesis of phenolic resin-based carbon aerogels for capacitors

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Herein we have reported the preparation of carbon materials for capacitors from phenolic resin in the presence of deep eutectic solvent (DES). Resole was used as carbon precursor and deep eutectic solvent synthesized from $ZnCl_2$ and urea in a molar ration of 3:10 served as pore former and mixed with the resole for the preparation of organic gels, which were then converted to carbon aerogels via carbonization. The physicochemical properties as well as the electrochemical properties of the obtained carbon products were investigated by X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Nitrogen absorption/desorption test, cyclic voltammetry (CV), galvanostatic charge-discharge (GCD) and electrochemical impedance spectra (EIS). The results show that the formation of DES, rather than the solid mixture of $ZnCl_2$ and urea, is more effective for the fast and low temperature preparation of phenolic resin-based carbon aerogels with higher specific surface area and enhanced electrochemical performance. After further activation, the carbon aerogel possesses a highest surface area of 1238.81 $m^2 \cdot g^{-1}$ and a highest specific capacitance of 179.6F$\cdot g^{-1}$ at the current density of 1A$\cdot g^{-1}$.

Keywords: phenolic resin, carbon aerogels, deep eutectic solvent, electrochemistry

P145

New impregnation of bulk wood for flow forming technique

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Wood flow forming is a new wood processing technique that has recently been developed. In this technique, bulk wood is processed into the compact with a favorite form by being compressed and flowed into a metal mold. The wood before compressed is required to be impregnated with chemical solution, to obtain a stable compact. In the conventional impregnation, however, there often remained two kinds of irregular distribution of chemicals, macroscopic and microscopic irregularities of chemicals. In wood with the macroscopic irregularity, there exist chemically treated cells and untreated cells, and in wood with the microscopic one, the amorphous structure in each cell wall often contains the untreated regions. Both of these irregularities may lead to the inadequate stability and low mechanical properties of the compact. In our studies, the impregnation process and subsequent conditioning process were newly developed to improve the microscopic and macroscopic irregularities. In this presentation, recent research as to new impregnation and conditioning processes will be introduced focusing on the mass transfer (flow of chemical solution and diffusion of chemicals) in wood blocks.

Keywords: Wood flow forming, Pretreatment, Impregnation, Conditioning, Mass transfer

P146

A comparison study of production of chitin nanocrystal with acidic deep eutectic solvents

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In this study, two kinds of acidic deep eutectic solvents (DESs) composed with choline chloride and organic acid were applied to fabricate chitin nanocrystals (ChNCs). ChNCs was successfully achieved using lactic acid DES with reaction time of one hour. Whereas, for oxalic acid dihydrate the reaction time should be extended to three hours. The yield of LA-ChNC1 (ChNCs fabricate by lactic acid DES) is 87.5%, while that of OA-ChNC3 (ChNCs fabricate by oxalic acid dihydrate acid DES) is 78%. The physicochemical properties were compared and studied through FTIR, AFM, XRD and TGA. All of the chitin nanocrystals are O-acylated with different groups. The average diameter of individual chitin nanocrystals is in range of 42 nm to 49 nm with average length range from 257 nm to 670 nm. A thorough investigation of the physicochemical characteristics changes of chitin revealed that the removal of amorphous area of chitin lead to increased crystallinity of ChNCs and a micromorphological diversity correlated the organic acid.

Keywords: Chitin, Nanocrystals, Deep Eutectic Solvents, Organic acid

P147

Effect of Deterioration in Cell Wall on Nanomechanics of Waterlogged Archaeological Wood from a 170-Year-Old Wooden Shipwreck

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The effects of morphological structure, chemical structure, chemical composition, porosity, and structural changes of cellulose crystalline on nanomechanical properties of waterlogged wood cell walls due to long-time underwater degradation were in situ analyzed with nondestructive nanoindentation (NI), attenuated total reflection fourier-transform infrared imaging (ATR-FTIR imaging) and confocal Raman microscopy (CRM), etc. It was found that the structures of the C=O stretching vibration in the O=C-OH group and equatorially aligned hydrogen on the C_2 atom in the mannose residue in polysaccharides were found seriously degraded; the lignin was slightly oxidized along with the degradation of carbohydrate; the amorphous polysaccharides in cellulose was revealed to be partly decayed; a huge number of mesopores occurred with the decrease of the relative crystallinity and the average crystal width in cellulose; what's more, bacteria decay was observed as a random mixture of intact and decayed fibers in transverse section. With all of these changes together, the resulting was a more than 25% decrease of the elastic modulus and hardness of WAW cell wall.

Keywords: *Hopea* sp., anatomic structure, mechanical property, chemical structure

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Identification and Classification of six *Pterocarpus* Species Based on Chromatography-Mass Spectrometry

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Pterocarpus santalinus and *P. erinaceus*, listed in CITES Appendix II, are the endangered timber species as a result of illegal harvesting and trade due to its high value and commercial demands. The growing demands for *P. santalinus* and *P. erinaceus* species with the morphologically similar other *Pterocarpus species* have resulted in confusion as well as identification problems. The application of chemical composition detection and analysis technology in wood species identification is a powerful complement to the traditional wood anatomical identification technology. It provides a new way for the classification and identification of wood. In this study, six *Pterocarpus* species including *P. santalinus*, *P. tinctorius*, *P. macarocarpus*, *P. erinaceus*, *P. soyauxii* and *P. angolensis* were studied based on several chromatograph-mass spectrometry, such as GC-MS, HPLC, MALDI-TOF-MS mapping, *etc.* The technology of chromatograph-mass spectrometry combined with multivariate statistical analysis was used to extract chemical information from xylarium wood specimens and to explore the feasibility of distinguishing these species. Significant differences were observed in spectra. Characteristic compounds with interspecific differences that can be used to identify wood species were screened out. Meanwhile, the provenance classification of six *Pterocarpus* species was discussed.

Keywords: *Pterocarpus* spp., wood identification, wood characteristic compound, chromatography-mass spectrometry, fingerprint database

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Anisotropic distortion of bamboo crystalline cellulose pretreated by novel levulinic acid based deep eutectic solvents for enhanced enzymatic hydrolysis

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Discovering green solvents and their inner mechanisms for efficient pretreatment to deconstruct lignocellulose biomass recalcitrance are hot topics recently. In this work, green levulinic acid (LA) based deep eutectic solvents (DES) were proposed for pretreatment on moso bamboo by combining acetamide (Am), betaine (Ba) and choline chloride (ChCl) as hydrogen bonding acceptors in the molar ratio 2:1. Chemical compositional analyses of pretreated samples were carried out as well as morphological observations. Small (SAXS) and wide angle scattering (WAXS) techniques were also applied for quantitative characterizations of microfibrillar and crystal structural variations. LA/ChCl system showed optimal enzymatic hydrolysis performance with the highest glucose yield (79.07%) followed by LA/Am and LA/Ba, which were due to more lignin removal and decreased crystallinity in the presence of chlorine. Moreover, cellulose experienced anisotropic distortion with more microvoids (averagely 30 nm) in horizontal direction and cracks in longitudinal direction that leads to shorter crystallites and microfibrils in length. The recycling studies revealed better recycle performance of LA/Ba DES because of the maintaining capability of extracting syringyl type lignin. The exploration for supramolecular structural changes of lignocellulose during the novel levulinic acid based DES may provide new understandings on selecting ideal solvents for effective biomass pretreatments.

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Effects of tempo oxidation and solid acid treatment on bacterial cellulose produced by acetobacter xyloides

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As a new kind of natural nanomaterials, cellulose has shown a broad application prospect in chemistry, physics, electricity, optics and biology in recent years.Due to its high purity, high mechanical properties, excellent biocompatibility and controllability in biosynthesis, bacterial cellulose has a broad application prospect in the field of biomedical materials, especially tissue engineering scaffolds.However, due to its long fiber length, it is difficult to 3D print and compound with other materials.TEMPO oxidation and solid acid treatment are two excellent methods for nanometer dispersion of cellulose.

Acetobacter acetobacter is one of the most studied bacteria.In this work, we used glucose as a carbon source to produce bacterial cellulose through standing culture.Bacterial cellulose was oxidized by TEMPO/NaBr/NaClO system and treated with 60% maleic acid concentration and a solid-liquid ratio of 1:10.After that, the solution was homogenized by high-pressure homogenizer and the concentration was adjusted to about 0.4%.The microstructure and mechanical properties of the samples were investigated by the determination of carboxyl content, FTIR, XRD, mechanical properties, thermogravimetry and AFM.

The results showed that the carboxyl content of bacterial cellulose treated with TEMPO oxidation and solid acid treatment was 0.98mmol/g and 0.29mmol/g, respectively, which was improved to some extent compared with 0.20mmol/g of the original membrane, and its dispersion was improved, especially the effect of TEMPO oxidation.It was found that the crystalline form of bacterial cellulose produced by this species was composed of about 86.2% cellulose I_{α} and 3.8% cellulose I_{β}, and the two modification methods did not change the crystalline form of bacterial cellulose.In mechanical properties, its resistance to damage: TEMPO oxidized > without treating > solid acid treatment.Due to the presence of weak polar carboxyl group and decarbonization of dehydrated glucuronate ester unit, the thermal stability of TEMPO oxidation is reduced and the early degradation zone appears.However, solid acid treatment has little effect on the thermal stability of bacterial cellulose.From SEM and AFM, it is found that the length-diameter ratio of TEMPO oxidation is larger, its flexibility is better, it has more advantages in scaffold materials, and it has broader prospects in 3D printing.

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Influence of deep eutectic solvents pretreatment on physicochemical properties and enzymatic digestibility of bamboo residues

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Lignocellulosic biomass is a kind of renewable and ecofriendly stock to produce the renewable and green materials and fuels due to its potential to be the alternative for fossil resource, which is in tight supplied and also playing a destructive role on natural environment problems, such as air pollution and global warming. Among these lignocellulosic biomass, bamboo residues has been found to be a promising material for biofuel production due to its remarkable storage and high carbohydrate content. Among the pretreatment methods, deep eutectic solvents (DESs) pretreatment is a promising pretreatment due to its excellent performance for improving the enzymatic hydrolysis efficiency by the high degree of delignification and removal of hemicellulose from raw materials.

In this work, bamboo residues were chosen as raw materials and pretreated with different molar ratio of choline chloride and lactic acid at different temperatures (110 ºC and 130 ºC). And residues' enzymatic digestibility was used to evaluate the effect of pretreatment. Meanwhile, the composition analysis and structural characterization of pretreated residues such as degree polymerization of residual cellulose and accessibility for cellulase were carried out to explore the correlation between enzymatic digestibility and material features.

The results showed that the recovery yields of pretreated bamboo residues were decreased with the increased ratio of LA in DES solution as the pretreatment at 110 ºC and 130 ºC. But the recovery yields of cellulose all kept above 92%, which demonstrated that DES pretreatment had a good retain for cellulose. Also, the deligninfiction was directly proportional to the increase of LA in DES solvent. When the molar ratio of LA was 1:8 at 110 ºC and 130 ºC. The degree of lignin removal reached to 42.2% and 84.1%, respectively. As for the pretreated bamboo residues, the enzymatic digestibility increased from 17.9% to 33.0% and 30.2% to 76.9% respectively when the ratio of LA increased from 2:1 to 1:8 at 110 ºC and 130 ºC. After the characterization analysis, it could be found that the removal degree of lignin and xylan, accessibility and DP had a positive correlation to the enzymatic digestibility with $R^2 > 0.7$.

Keywords: bamboo residues, DES solvents, pretreatment, enzymatic hydrolysis, lignin

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Reducing the effect of ash on waste wheat straw autohydrolysis to improve cellulose conversion by pre-soaking with metal cations

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Waste wheat straw (WWS) is a waste generated from wheat straw in the pulping and papermaking process, which is a kind of lignocellulose containing a large amount of free ash. The researches found that the acid buffering capacity of high free ash in WWS has a great obstacle to the efficiency of autohydrolysis pretreatment, that is, free ash destroyed the weak acidic of autohydrolysate in autohydrolysis because of its ability to ion exchange, and reduced the acidity of the autohydrolysate, which weakened the extent of xylan removal, and was not conducive to further cellulase hydrolysis of WWS. In this work, different metal cations (K^+, Na^+, Ca^{2+}, Mg^{2+}, Zn^{2+}, Fe^{2+}) were used to pre-soak WWS in order to overcome the negative effects of ash during the autohydrolysis process, and further improved the enzyme digestibility of WWS after pretreatment. The results showed that the added cations can be adsorbed on the surface of the ash of the material by electrostatic adsorption, which can change the acid buffering capacity of ash. When 120 mM Fe^{2+} was used to pre-soak WWS, its acid buffering capacity was reduced from 226.3 mmol/pH-kg of the original WWS to 79.3 mmol/pH-kg. This reduced the pH of the autohydrolysate from 5.7 to 3.8, and promoted the removal of xylan from 61.7% to 83.7%. The enzyme digestibility of WWS was increased from 49.7% to 86.3% by pre-soaking with 120 mM Fe^{2+} solution. At the same time, the accessibility and hydrophobicity of cellulose in pretreated WWS, and its relationship with the enzyme digestibility of pretreated WWS were analyzed by dye adsorption experiments. The results showed that the metal cations pre-soaking method is a method that effectively destroyed the effect of ash on the autohydrolysis of WWS, and is also a method to improve the enzyme digestibility of pretreated WWS.

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Preparation of water-soluble lignin-modified cellulose nanofiber film with anti-ultraviolet and antibacterial properties

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With the continuous fermentation of environmental issues and the overexploitation of fossil resources, people committed to exploring renewable materials from biomass to substitute the traditional petroleum-based materials.As a renewable polymer extracted from natural plants, cellulose,specifically for cellulose nanobrils (CNFs), has attracted wide attention as a new renewable one-dimensional material over the past decades.CNF films,which fabricated from CNFs, are of great interest to researchers mainly due to its potential functional substrates such as excellent optical properties, low thermal expansion, and high mechanical strength.Based on this properties, CNF films shows a wide range of untapped potential, such as biodegradable packaging for food and beverages, biomedical materials for wound dressings and as membranes in water treatment technology.

In this work, an efficient and sustainable route, which blended different concentrations of water soluble lignin (WSL) and cellulose nanobrils (CNFs), was reported to fabricated lignin containing cellulose nanofifibrils films (CNF-WSL films) with anti-ultraviolet and antibacterial properties. CNFs was obtained from SBKP by NaClO/NaBr/TEMPO oxidation technology. Water soluble lignin (WSL),which isolated by the hydrophobic XAD resin from mixed hardwood, can be used to prepare various phenolic compounds, fuels, and bio-based materials, due to its low molecular weight, abundant hydroxyl groups, and water soluble property.

The compositing of WSL increased both the antibacterial and anti-ultraviolet properties of the resulted film. The optical transmittance is closely related to the thickness of the film, therefore curve Normalized at 600nm.Results show that with the increase of WSL(from 0.5%-10%), the optical transmittance decreased from 86%(pure CNFs) to 60%(CNFs-WSL-10), however,the UV resistance of the UVC band (200-275nm)and UVB band (275-320nm) is significantly enhanced while WSL concentration is 7% and 10%.The inhibition zone of E. coli and S. hemolyticus increased from 6 mm to 6.72-9.76 mm and 6.89-10.49 mm when the WSL concentrations in CNF-WSL films were increased from 0% to 1-10%.Meanwhile,Hydrogen bonds between cellulose nanofibrils are disturbed by lignin in the film, which reduces the mechanical properties of the film, such as tensile stress and Young's modulus.In short, this work helped the research of cellulose and lignin composite films with properties such as Outdoor anti-ultraviolet material and Antibacterial packaging.

Keywords: cellulose nanofifibrils films;water soluble lignin, anti-ultraviolet, antibacterial

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