Open seminor- 52 (13/6/2007)

Center for Exploratory Research on Humanosphere, RISH, Kyoto University

1. Title:

Development of bacterial cellulose-based functional biomaterials

バクテリアセルロースを骨格とする機能性バイオマテリアルの開発

2. Speaker:

Thi Thi Nge (Mission Scientist)

3. Collaborator:

Junji Sugiyama (Professor, Lab. of Biomass Morphogenesis and Information, RISH)
Hiroo Iwata (Professor), Koichi Kato (Associate Professor) (Department of Reparative Materials, Institute for Frontier Medical Sciences, Kyoto University)

4. Related Mission:

Mission 4 – Development of Technology and Materials for Cyclical Utilization of Bio-based Resources

5. Summary

Application of microbially derived cellulose, bacterial cellulose, as biomedical materials has drawn considerable attention in recent years due to its unique nanofibrillar structure with native mechanical property, high water holding capacity, modability and biocompatibility. In contrast to cellulose extract form plant cells, bacterial cellulose (BC) is completely pure and free from biogenic compounds (lignin, pectin, arabinan,etc.) that are present in plant cellulose. The in vivo biocompatibility evaluation of BC in rat model has demonstrated that BC is well integrated into the host tissue and does not elicit any chronic inflammatory reaction and potential to be used as scaffolds in tissue engineering. Tissue engineering, a technique to create artificial constructs to direct tissue generation from culture cells, is now being considered as a potential alternative to organ or tissue transplantation. It is generally based on the use of biodegradable polymeric scaffolds with appropriate porosity for mechanical support and tissue guidance, and in some cases as carrier for growth factors to accelerate healing process when placed in vivo.

In this study, BC has been used to develop functional scaffold materials and their ability to support and direct new tissue formation possibly for bone and cartilage tissue engineering will be investigated. It is widely accepted that surface chemical structure exerts a significant influence to induce an apatite layer on materials surface in physiological conditions as well as to promote cells attachment, proliferation, growth and differentiation when the materials are exposed to biological environments. Surface modification and/or bulk modification are thus performed to render materials biomimetic. Modification of BC includes biofunctionalization (addition of amino sugars during cellulose biosynthesis), and chemical functionalization. Naturally occurring biopolymer chitin/chitosan (monomer and/or polymer) and cell-binding peptides are intended to use for this purpose because amino sugar or *N*-acetylglucosamine moiety in chitin/chitosan shares the structural feature that found in glycosaminoglycan (GAGs) of extracellular matrix (ECM) of cartilage, and cell-binding peptides can promote cell adhesion and proliferation. The modified scaffolds in combination with alternate soaking process in calcium and phosphate solution for apatite formation make the developed BC composites as potential tissue constructs for osteological applications.