Classification of DLC films in terms of biocompatibility

Prof. Yasuharu Ohgoe, Division of Electronic & Mechanical Engineering,
Tokyo Denki University, Japan

Abstract
In this study, various kinds of diamond-like carbon (DLC) films were classified in terms of their biological responses (specifically number of adhering cells). Forty three kinds of DLC samples that had been deposited on Si substrate by various physical vapour deposition (PVD) and chemical vapour deposition (CVD) system equipment were obtained from coating companies, universities, and public organizations in Japan. Mouth fibroblasts (NIH-3T3) were used to estimate the cellular responses on the DLC samples. During the cell culture, 12 of the DLC samples were peeled off from the Si substrates. As a result, the remaining 31 DLC samples with a wide range of properties were classified into four groups in terms of their number of adhering cells. Group 1 (high density, low sp2 content, and low hydrogen contents) and Group 2 (low or medium density, high sp2 content, and low hydrogen contents) had low number of adhering cells. Group 3 (medium density, and medium sp2 content, and relatively high hydrogen contents) and Group 4 (low sp2 content, low density, and wide range of hydrogen contents) had a wide range of number of adhering cells. It was shown that this classification is one of design criteria of DLC film deposition for biomaterials regardless of the various deposition systems equipment. It is expected that ordinary DLC users can carefully select a DLC film for specific applications to medical devices using the classification.

Biography
Yasuharu Ohgoe, PhD joined the division of electronic and mechanical engineering, school of science and engineering, Tokyo Denki University as associate professor of engineering. He received his PhD from Applied System Engineering, Graduate School of Science and Engineering, Graduate School of Tokyo Denki University in 2005. His work has focused on carbon-based materials for biomedical applications. His primary research is classification of diamond-like carbon (DLC) films in terms of biological response, investigation of hydrogenated amorphous carbon (a-C:H) films properties including DLC for biomaterials, and development of a-C:H films deposition techniques for polymeric 3-dimensional structures by plasma CVD.

Nanostructured Biomaterials for Regenerative medicine

A/Prof. Haifeng Chen, Department of Biomedical Engineering,
College of Engineering, Peking University, Beijing, China

Abstract
Nanostructured biomaterials have been widely explored for a variety of biomedical applications such as drug delivery, bioimaging and regenerative medicine because of their unique functionalities and features. In this talk, I will first discuss our recent progresses on the development of chemical
approaches for the regeneration of biomimetic dental enamel structure for dental care. Our research scheme is focused on the bottom-up nanofabrication methods, which would be either to self-assemble the nanorod-like apatite crystals into an enamel-like hierarchical structure or to control the growth of enamel-like hierarchical structure directly. The reconstructed layer is analogous to the natural enamel’s chemical components, micro-architectural structure and mechanical properties, and could efficiently whitens teeth. The synthesis of these apatite nanocrystals is carefully controlled in terms of size and morphology. After doped with different rare-earth elements, apatite crystal could present downconversion and upconversion properties and could emit visible fluorescence when excited by UV or near-infrared (NIR) laser. Cell and animal study show that the new fluorescent labeling material has good biocompatibility and surface modification properties. We are able to label and track the differentiation of bone marrow mesenchymal stem cells in vitro and in vivo. This has provided a new tool for in vivo labeling and tracing apatite-based implant materials, particularly for the study of the implant and the tissue interface. My discussion will then be focused on the development of nanostructured scaffolds for regenerative medicine. We have developed a new type of ceramic scaffolds based on electrospun titanium dioxide with osteoinductive properties, which is expected to be applied in bone tissue engineering. We have developed a scaffold based on polycaprolactone electrospun nanofilm that is able to significantly enhance the MSC recruitment both in vitro and in vivo. This scaffold is covalently conjugated with a short peptide which has a high specific affinity to MSCs. By mimicking the natural extracellular matrix (ECM) environment of tissue which can enhance cell differentiation and production of local factors for natural tissue repair and regeneration, we have developed a coaxial electrospun scaffold which is able to co-deliver of BMSC-Affinity peptide and rhTGF-β1. This scaffold could significantly promote the chondrogenic differentiation ability of BMSCs. Given the various regenerative properties of BMSCs, these scaffolds are expected to provide a wide range of potential applications in regenerative medicine.

Biography
Haifeng Chen is currently a tenured associate professor at the Department of Biomedical Engineering, College of Engineering, Peking University. He received his B.S. degree (1993), M.S. degree (1996) from Lanzhou University and Ph.D. degree (1999) from Peking University. He then worked as a postdoctoral fellow in Prof. Colin Robinson and Prof. Jennifer Kirkham’s group at the University of Leeds (1999-2001) and in Prof. Brian H. Clarkson, Prof. Mark M. Banaszak Holl and Prof. Bradford G. Orr’s group at the University of Michigan (2001-2002). He worked as a research investigator at the University of Michigan, School of Dentistry (2003-2006). He joined Peking University in 2006. Dr. Chen’s research efforts are in the areas of biomaterials and regenerative medicine, especially in the dental and orthopedic applications. Dr. Chen’s current research focuses on the dental enamel regeneration for tooth repair, TZP for all ceramic dental restorations, tissue engineering scaffolds and fluorescent nanocrystals for labeling cells and tissue. In addition, He also engages in translational research on dental ceramics, dental resin and dental implants.