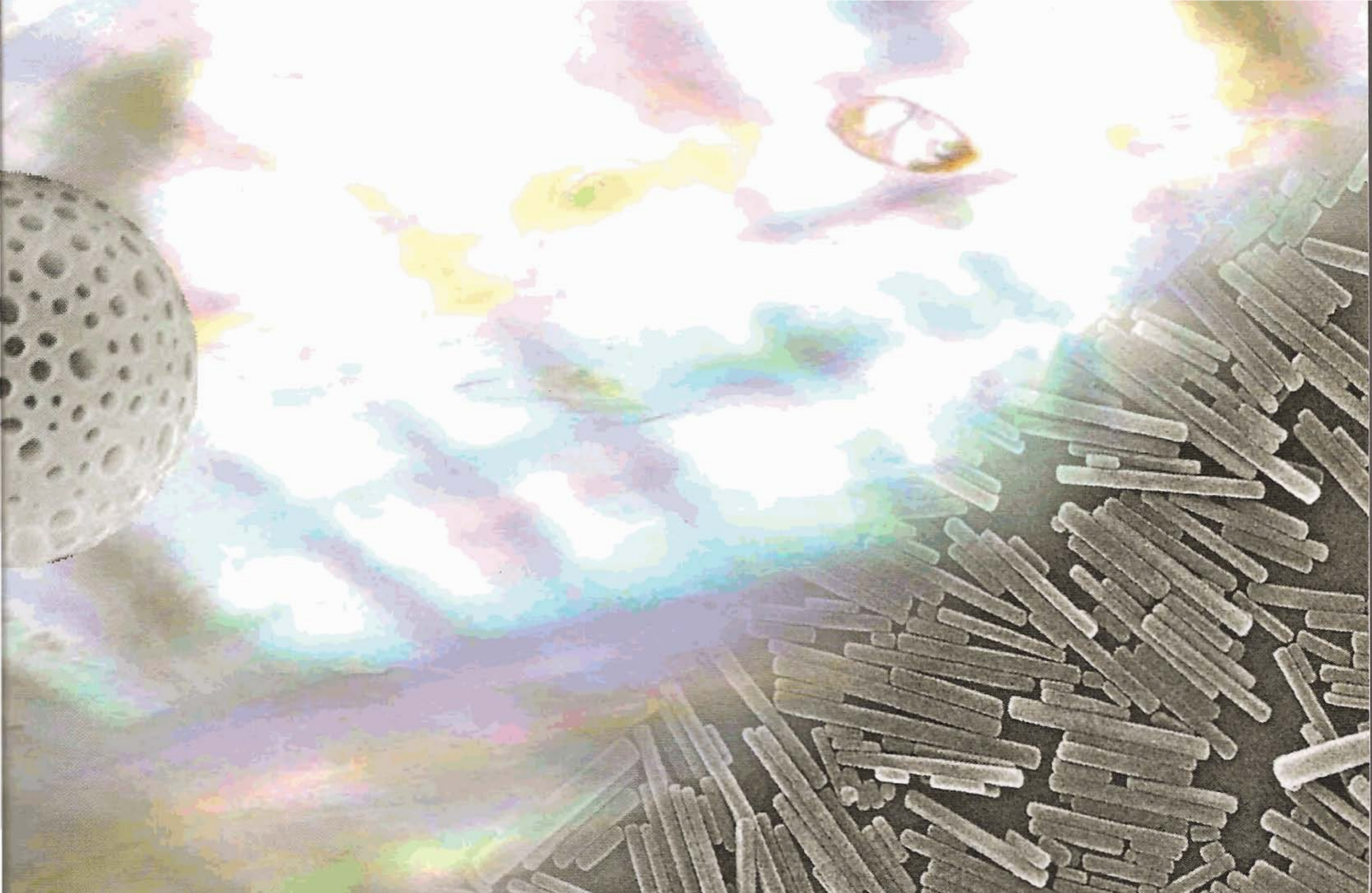
MRS-J
The Materials Research Society of Japan

The 17th Symposium of The Materials Research Society of Japan

- Advanced materials researches cut paths to innovation -

Program and Abstracts

Dec. 8 (Fri.) - Dec. 10(Sun), 2006, Nihon University



Session K「イオンビームを利用した革新的材料」
" Innovative Material Technologies Utilizing Ion Beam "

チェア/Chairpersons：岸本直樹/ Naoki Kishimoto（物材機構/NIMS）、
辻　博司/ Hiroshi Tsuji（京大/kyoto Univ.）、池山雅美/ Masami Ikeyama（産総研/ AIST）、
鈴木嘉昭/ Yoshiaki Suzuki（理研/ RIKEN）、馬場恒明/ Koumei Baba（長崎工技セ/ Ind. Tech. Cent. Nagasaki.）、
福味幸平/ Kohei Fukumi（産総研/ AIST）、末松久幸/ Hisayuki Suematsu（長岡技科大/ Nagaoka Univ. Tech.）

For half a century, ion beam technology has made a significant contribution to the progress of materials science through the application to material analysis and synthesis, as a leader of innovative technologies. Recently, quantum-beam-driven innovation has been advocated and, particularly, ion beams are applicable for materials synthesis and processing using various unique characteristics, such as non-equilibrium processes, good controllability of atomic injection, etc. This session will address the challenges associated with innovative material technologies that utilize ion beam. Specifically, papers that focus on the ion-beam synthesis of advanced materials such as, nano-materials, non-equilibrium materials, bio-materials, etc. as well as new utilization techniques of ion beam are encouraged.　We are looking forward to having broad, interdisciplinary discussions that will lead to breakthrough in materials science.

＜12月9日（土）, December 9 (Sat)＞
■口頭発表（日本語または英語セッション）
午前の部（121 教室　9:30 ～ 12:00）
<Morning oral session (in Japanese or English) at room 121, 9:30 - 12:00>
午後の部（121 教室　13:00 ～ 15:50）
<Afternoon oral session (in Japanese or English) at room 121, 13:00 – 15:50>
■ポスター発表　Poster Presentation
夕方の部（CST ホール　16:00 ～ 17:30）
<Poster session at CST hall in afternoon, 16:00 – 17:30>

＜12月10日（日）, December 10 (Sun)＞
■ポスター発表　Poster Presentation
朝の部（CST ホール　9:00 ～ 10:30）　昼の部（CST ホール　11:00 ～ 12:30）
<Poster session at CST hall in morning, 9:00 - 10:30> <Poster session at CST hall in morning, 11:00 – 12:30>
■口頭発表（日本語または英語セッション）
午後の部（121 教室　13:30 ～ 18:00）
<Afternoon oral session (in Japanese or English) at room 121, 13:30 - 18:00>

INVITED
12月9日
9:30 - 10:00 [K-01-I]　Invited
「Fabrication and Surface Modification of Microelectronic Structures and Biomaterials by Plasma and Ion Beam Technology」○Paul K Chu (Department of Physics, City University of Hong Kong, Kowloon, Hong Kong, China)
10:00 - 10:30 [K-02-I]　Invited
「Low-energy Ion Beam Modification of Living Materials: Ion Beam Induced DNA Transfer and Mutation」○Liangdeng Yu (Fast Neutron Research Facility, Department of Physics, Chiang Mai University)
10:30 - 11:00 [K-03-I]　Invited
「Surface Modification of Silicone Medical Materials by Plasma Based Ion Implantation」○Tomohiro Kobayashi (RIKEN)
13:00 - 13:30 [K-07-I]　Invited
「Recent Progress and Prospects of Cluster Ion Beam」○Jiro Matsuo (Quantum Science and Engineering Center, Kyoto University)
13:30 - 14:00 [K-08-I]　Invited
「Thin Film Deposition by Ion Beam Evaporation」○W. Jiang (Nagaoka University of Technology)
14:00 - 14:30 [K-09-I]　Invited
「The electrical and optical properties of GZO/AZO/ZnO thin films deposited on polymer substrates by ion beam sputtering」○Chongmu Lee (Dept. of Materials Science and Engineering, Inha Univ.)
15:00 - 15:30 [K-10-I]　Invited
「Ion Beam for Nanofabrication」○Ka-Ngo Leung (Lawrence Berkeley National Laboratory and Nuclear Engineering Deptartment, University of California)

Fabrication and Surface Modification of Micro-electronic Structures and Biomaterials by Plasma and Ion Beam Technology

Paul K Chu, Department of Physics & Materials Science, City University of Hong Kong, Kowloon, Hong Kong, China, E-mail: paul.chu@cityu.edu.hk

Plasma surface modification is an effective and economical surface treatment technique for many biomaterials. The technique offers the unique advantage that the surface properties and biocompatibility can be enhanced selectively while the favorable bulk characteristics of the materials remain unchanged. For instance, mechanically sturdy materials with good wear and corrosion resistance can be modified to improve the surface bioactivity in biomedical applications. Existing materials can thus be used and needs for new classes of materials may be obviated thereby shortening the time to develop novel and better biomedical implants. Recent works conducted in our laboratory pertaining to the production of novel silicon-on-insulator (SOI) materials to reduce the self-heating effects and improvement of surface bioactivity and properties of biomaterials will be presented in this invited talk. SOI MOSFET is expected to replace conventional bulk silicon substrates in many microelectronic devices because it possesses many advantages such as the reduction of parasitic capacitance, excellent sub-threshold slope, elimination of latch up, and resistance to radiation. However, wider applications of SOI in ULSI are hampered by the self heating effects caused by the poor thermal conductivity of the buried silicon dioxide layer. We have recently explored alternative buried insulators with better thermal conductivity and successfully fabricated SOI structures using aluminum nitride or diamond-like carbon as the substitute for the buried silicon dioxide layer. The recent progress will be described in this talk. NiTi shape memory alloys possess the shape memory effects and super-elasticity and are the ideal materials for spinal deformity correction in orthopedic surgeries. However, the leaching of Ni ions from the materials causes health concerns. We have recently employed plasma immersion ion implantation and deposition to modify the surface of the materials and our results indicate that out-diffusion of Ni is significantly mitigated. We have also recently discovered that nanostructured TiO_2 favors the growth of apatite. Last but not least, our work on the antibacterial properties of plasma-treated polymers will be described.

K-02-I

Low-energy Ion Beam Modification of Living Materials: Ion Beam Induced DNA Transfer and Mutation

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Low-energy ion bombardment of living materials is a novel technology for genetic modification and life science study purposes that are receiving growing attention from the physical and biological communities. The interaction between energetic ions and biological organisms is quite different from that between ions and normal solids and thus is full of mysteries and research interests. The ion-beam bombardment for direct DNA transfer in both plant and bacterial cells and mutation breeding has been successfully demonstrated. In the former case, ions at appropriate energy and fluence pierce only the cell envelope and provide facilities for the exogenous macromolecules to be transferred into the cell. In the latter case, the DNA structure inside the cell nucleus is modified randomly by ion-beam irradiation and positive mutations are subsequently selected for propagation. The mysteries existing are what is created by ion beam at the cell envelope for gene to pass through and how the genetic substance deeply inside the cell can be modified by the ions that have the range orders shorter than the depth of the substance. Attempts have been made to understand the process details and to develop a consistent physical mechanism for these significant results. Here we review the present status of the physics and technology of low-energy ion bombardment of living organisms, mainly with progress achieved at Chiang Mai University.

K-03-I

Surface modification of silicone medical materials by plasma-based ion implantation

T.Kobayashi, Y.Suzuki, M.Iwaki, T.Yokota[1], R.Kato[1], T.Terai[2], N.Takahashi[2], T.Miyasato[3] and H.Ujie[4]
The Institute of Physical and Chemical Research (RIKEN), Saitama 351-0198, Japan, t-koba@riken.jp, [1]The University of Tokyo, Tokyo 113-0033, [2]Tokyo University of Science, Tokyo 162-8601, Japan. [3]Yaesekai Dojin Hospital, Okinawa 901-2133, Japan. [4]Tokyo Women's medical Univ., Tokyo 162-8666, Japan

Silicones (polydimethylsiloxane) are biologically inert material and widely used in medical treatment. An invasion of germs along the catheters is one of the problems due to their poor adhesion to tissues when it applied for dialysis. In this study the surfaces of silicone sheets and tubes were irradiated by a plasma based ion implantation (PBII) method and biocompatibility was improved. Also, the changes in their composition, structure, morphology and hydrophilicity were investigated. The cell attachment percentage improved from 50 % to 85 % by the irradiation and declined at high energies. This tendency almost agrees with the change in hydorophilicity of the irradiated surface. The surfaces became hydrophilic at the low voltage with increasing -OH and C=O bonds. On the other hand, they turned into hydrophobic at high energies due to a drastic increase of the surface roughness. The catheters implanted beneath a skin of a rabbit for 3 weeks showed quite good attachment compared with unirradiated one.

K-04-D

Mesenchymal Stem Cell Attachment Properties on Silicone Rubber Modified by Carbon Negative-Ion Implantation

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The effects of the carbon negative-ion implanted into silicone rubber sheet (SR, Wacom Electric co., ltd) through the pattering mask aperture slits of 50-μm width on the attachment properties of mesenchymal stem cells (MSC) were studied. Contact angles of SR sheet implanted at the same conditions without the pattering mask were measured by water drop and air bubble. The implantation conditions were various ion doses from 10^{13} - 1×10^{16} ions/cm^2 at ion energy of 10 keV. Each C-implanted sample was sterilized before culture. MSC, from rat bone marrow (BM), of passage 3 were cultured on the modified surfaces in the medium of DMEM with 5% horse serum and 5% fetal bovine serum for 20-25 days under 5% CO_2 at 37°C in incubator. The culture medium of each dish was replaced every 4 day. The phase contrast micrographs (CK2, Olympus) show the attachment of cells only on the stripe regions implanted with doses from 10^{15}- 10^{16} ions/cm^2. The good conditions for cell attachment are 3 and 10 ($\times10^{15}$) ions/cm^2 of ion doses corresponding to the low contact angle, which is 69 and 61 degree. The fluorescence micrographs (BX50, Olympus) also show the position of cell nucleus and the actin filament on the implanted region at these implantation conditions. As implanted at low dose, no cell attached and cells very weakly attached.