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Fabrication of Novel Silicon-on-Insulator Materials and Enhancement of Surface Properties of Biomaterials and Nano-Structured Biomaterials Using Plasma Immersion Ion Implantation and Deposition

PAUL K CHU

Department of Physics & Materials Science, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong, China

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.

Silicon-on-insulator (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 biocompatibility of single-crystal silicon will be presented. Enhancement of the surface biocompatibility of silicon is important to the development of silicon-based biosensors.