Seminar

Institute for Plasma Research

Title : Development of Smart Bio-Materials

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Date : 7th September 2018 (Friday)

Time : 03.30 PM

Venue : Committee Room 3, (New Building), IPR

Abstract :

The global market size of smart biomaterials is all set to touch ~19 billion US$ by 2017 with a further growth to ~ 27 billion US$ by 2022 (***http://www.marketsandmarkets.com***). Aim of our work to prove that the advance surface engineering techniques e.g. plasma nitriding and multilayering by physical vapour deposition is very much suitable for development of advanced cheaper biomaterials for societal development, like load-bearing hip implant, knee implant, other related implants including pins, rods, screws, and plates used in treatment of bone fractures, osteoarthritis, scoliosis, spinal stenosis, and chronic pain. Tribological properties, corrosion and wear in body fluids were a major problem for metallic implants. During the last decade for a two year period from 2006 to 2008 the number of primary total hip replacement (THR) was 689,608 with a revision surgery number of 79,231 in the developed countries alone (***Labek et al., 2011***). For the same period, the number of primary total knee replacement (TKR) was 377,462 with a revision surgery number of 19,752 in the same developed countries (***Labek et al., 2011***). So in order to avoid such revision surgery and chronic pain of the patient, such nano/micro tribological properties, corrosion and wear resistance in body fluid found to have been improved for such biomedical load bearing implants through plasma nitriding and Ti/TiN multilayering, but still the suitable optimization needs to be carried out.

Recent studies also showed that bioimplants could be infected by different microorganisms due to non-sterilized operational conditions and consequential formation of biofilms found especially in Ti alloy based implant. For example, 30% of the prosthetic biomaterials are reported to harvest microorganism leading to local infection causing haematogenous spreading. Biofilm modifies physico-chemical activities of body fluid and tissues thereby causing blood clotting, tissue damage etc. In adverse situation, lack of proper care leads to cancer. To inhibit these problems, it is very necessary to impart anti-bacterial, biofilm and anticancer activity to such bioimplants for the generation of smart biomaterial. Nano Au, nano Ag, nano/micro Ca-based composite, graphene sheets, carbon dot based composite nanostructure could play a significant role regarding this matter. Various antibacterial, antibiofilm coatings development on such developed biomedical implants will be our future endeavour. Novel antibacterial, antibiofilm and ant infectious materials can generate sufficient amount of reactive oxygen species (ROS) and reactive nitrogen species (RNS) both in dark and in presence of photo lights (UV lights), thus very much prone to photo thermal (PTT) and photodynamic (PDT) therapeutic applications. *In tissue engineering* application prospective, success rate of hard tissue scaffolds depends upon balance between good mechanical properties, biocompatibility and porous architecture. Porous Mg-alloy, Ti alloy are used as scaffolds in recent days due their good mechanical properties. Our approach is to use the modern surface engineering technique to impart antibacterial and antibiofilm activity to these scaffolds.

Last not but the least, *In-vivo* investigation on the efficacy of the surface engineered implantable smart biomaterials by using animal model to identify the roadmap for future human trial to be possible.