Seminar

Institute for Plasma Research

Title : Plasma-surface: Interaction, Optimization and Applications

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Time : 03.30 PM

Venue : Online - Join the talk: https://lobby.ipr.res.in/Dr.SupriyaMore_PDFTalk

Abstract :

Looking at the increasing scope of plasma used for materials surface processing, here we present the interaction of a microwave assisted Electron Cyclotron Resonance (ECR) plasma species suitable for surface modification of bio-compatible polymers and metal film. Prior to the surface-treatment, a detailed diagnostic mapping of the plasma parameters throughout the reactor chamber was carried out by using single and double Langmuir probe measurements in Ar plasma. Further, Nylon 6 polymer surface used as a representative candidate, where the effect of plasma forming gases (like Ar, H2+N2/HN, O_2), treatment time and axial distance for treatment were varied in the ECR processing chamber. It was found that post plasma treated N6 polymer surface energy and morphology can be easily tuned by understanding of axial mapping of plasma properties within reactor.

Similar kind of surface property optimization was done on UHMWPE (Ultra High Molecular Weight Poly-ethylene) by using HN and O_2 plasma. The ECR plasma was found to be suitable to enhance the surface energy and generate C-N/C-O related functional groups that were found to be associated with enhancement of cellular adhesion. In order to investigate its application in bone tissue engineering, interactions of modified UHMWPE with two major classes of bone cells: osteoblasts and osteoclasts, has been elaborated. The results clearly indicate a positive cellular interaction of the polymers treated for 1 min with O_2 plasma as compared to their HN plasma treated counterparts. However, we also emphasize that the type of plasma and the duration of treatment, play a major role in governing the proliferation and differentiation of a particular cell type. This means that the duration of plasma treatment governs whether the polymer surface would support osteoblast or osteoclast differentiation.

Another work involves the generation of O_2 plasma species at low pressure utilizing an Electron Cyclotron Resonance (ECR) plasma reactor, and their interactions with micron- and nano- sized iron films (M-Fe and N-Fe film respectively) prepared using ethyl cellulose processed at high temperature. As a result of the interaction of O_2 plasma species and temperature, iron was oxidized to different polymorphs depending on the operating pressure and hence O_2 gas flow rate. The phase, as well as the morphology of the film was controlled by monitoring the oxygen flow rate using the unique Plasma-Assisted Thermal Oxidation (PATO) process. Different morphologies such as polygonal, compact facets, wire-like (1D) nanostructures at the surface were obtained for the films processed using PATO. The selected PATO-processed films were investigated for Field Electron Emission (FEE) properties.