NANPROCESSING AND 3D NANOANALYSIS AT THE BIOINTERFACES

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It is significantly important to understand the biointerfaces and surface bioactivity behavior, as well as the microstructure of material, in order to design and develop novel and functional biomaterials. Especially the properties of interaction surfaces in biomaterials is much of interest when these materials are implanted inside the body or interacted with the living cells. The body-material contact is often observed for confirming the biocompatibility of the novel materials and therefore cross-sectional investigations are to be performed between the layers providing high resolution data. Also, surface characteristics; such as, roughness, morphology, texture, adhesion properties and wettability; play an important role in the interaction of the materials and the biological media. Therefore, tuning of the surface features via controlled modification techniques at high definition is very crucial for the use of functional surfaces in nanobiomedical and bioengineering applications.

The Focused Ion Beam - Scanning Electron Microscope (FIB-SEM) processing microscope systems provide the use of electrons and ions for simultaneous serial slicing – imaging and chemical analysis. By this means, 3D cross-sectional an information can be obtained for micro/ nanostructural, morphological and elemental distribution. FIB-SEM platforms help to reveal biointerfaces at high resolution and are able to prepare ultrathin cross-sectional samples for TEM analysis for a better characterization of nano and sub-nano interfaces. Also when biomaterials include e.g. fibers, channels, pores and micro cracks, these details can be investigated along the sliced regions.

In this study, advanced FIB-SEM nanostructuring, patterning and characterization applications were used to determine morphological, chemical and structural features of biointerfaces, layered biomaterials and nanobiocomposites in three dimensions. Especially ion slicing and electron imaging processes were used to examine the biointerfaces and inner structures of both hard materials and soft tissues and provide detailed information. These materials include metal and ceramic implants and biocompatible coatings. In addition, FIB-SEM platforms were used for generating patterns with different designs and doses, in order develop bioactive interfaces on ceramic and polymer materials. These surfaces were then subjected to cell adhesion and proliferation experiments and the relation between surface properties and bioactivity was examined by complementary imaging techniques.