CIC biomaGUNE: CIF: G-20788840· Parque Tecnológico de San Sebastián · Pº Miramón 182· 20014 San Sebastián (Gipuzkoa)· Tel.: + 34 943 00 53 00· Fax: + 34 943 00 53 01· info@cicbiomagune.es ·www.cicbiomagune.es

CIC biomaGUNE
CENTER FOR COOPERATIVE RESEARCH IN BIOMATERIALS

seminar

Tuesday, 18th December, 12.00 pm, Seminar Room

Host: Dr. Sergio Moya

Functionalized mesoporous titania film coatings for bone implants with antibacterial and enhanced osseointegrative properties

Ane Escobar
Soft Matter Nanotechnology Lab
CIC biomaGUNE

There is an urgent need for the development of effective antibacterial coatings to cope with more and more resistant bacterial strains in medical environments, and particularly to prevent nosocomial infections following bone implant surgery. There are two main approaches to tackle this important issue: (I) directly prevent bacterial infection by the use of antibacterial coatings or (II) indirectly avoid bacteria proliferation by enhancing pre-osteoblast attachment, proliferation and differentiation in order to get a faster osseointegration of the implant and form the protective capsule, which would avoid infection, as fast as possible.

Here we will present the work conducted in my PhD thesis focused on the development of antibacterial and bioactive mesoporous titania films (MTFs). MTFs films have the advantage that they posses a pore structure, which can be used for encapsulating drugs as well a large active surface from the porous structure.

We will show different approaches for the functionalization of MTFs with growth factors and antibiotics. Antibiotics are incorporated in the pores of the MTF or assembled on top forming complexes with polyelectrolytes through the layer-by-layer technique.

Gentamicin, an aminoglycan antibiotic, has been encapsulated in the pores of MTFs by soaking the MTF in a gentamicin solution and the surface has been functionalized with human recombinant Bone Morphogenetic Protein 2. Gentamicin is liberated in PBS with an initial burst release followed by a slower and sustainable release over weeks. *S. aureus* is prevented from growing on the gentamicin loaded MTF. The presence of the growth factor on the MTF has a positive effect on MC3T3-E1 pre-osteoblastic cell attachment, proliferation and differentiation.

Alternatively, polyelectrolyte multilayers (PEMs) formed with gentamicin-poly (acrylic acid) complexes and poly-L-lysine are assembled on top of the MTFs. Obtained PEMs are stable at physiological pH but liberate gentamicin, showing effective antibacterial properties against *S. aureus* proliferation.

Bioactive ions can boost the proliferation and differentiation processes of pre-osteoblasts. Bioactive ions like Strontium or Magnesium can be incorporated to the titania matrix, but they must be released in the physiological environment in order to act effectively. Profiting from the larger available surface for ion exchange in MTFs, which is much larger if compared with non-mesoporous titania, we have incorporated Sr to MTFs by two routes: 1) we have directly incorporated strontium in the titania matrix and 2) we have complexed strontium to carboxylate groups previously anchored to the titania pores.

In the first approach, strontium titanate mesoporous films (SrTiMFs) with a 20 % Sr molar content have been prepared. In the second approach, inorganic−organic hybrid MTFs with covalently bonded carboxylic acid groups have been synthesized. The availability of the COOH groups for further chemical modification is demonstrated by Diffuse Reflectance Infrared Fourier Transform Spectroscopy by following the changes in the typical carbonyl IR bands during proton exchange and Sr2+ complexation.

Both, SrTiMFs and the hybrid MTFs with complexed Sr release strontium in the media showing a positive effect on the attachment, proliferation and differentiation of MC3T3-E1 pre-osteoblastic cells.