PhD Project	Host institution	Start date (e.g. Month 6)	Duration (e.g. 48 months)	Supervisors (primary and co-supervisor)
P2	**TUW**	**1**	**48**	**A. Otto/M. Raith** **Associate Expert S. Gruber**

Project Title: Laser structuring and activation of biopolymer surface coatings

Hypotheses/Aims:
Many polymers are of synthetic origin and their biocompatibility is much more limited than that of natural polymers such as cellulose, chitin or chitosan. Chitosan in particular, as a natural biopolymer, has excellent properties such as biocompatibility, biodegradability and non-toxicity, which made the material suitable for applications, like tissue engineering or as surface coating to improve osseointegration. Since surface topography plays an important role in cell growth required for fast integration into tissue as well as on bacterial adhesion, laser treated hierarchical surfaces will be investigated in detail to reveal influences of structure size and shape on integration into tissue and biofilm development.

Short Description of the PhD project and Role of both Organizations (TUW & FHCW):
Femtosecond laser processing of surfaces enables to achieve not only hierarchical structures ranging from µm to nm, but minimize thermal damage to sensitive materials, too. Depending on processing parameters, different surface structures, like laser induced periodic surface structure (LIPSS) with periodicities in the sub-µm range, or µm-sized cones, grooves or cauliflower-like structures are formed. Such structures could not only improve cell growth, but also control cell growth direction to a certain extent. Another aspect to be investigated is the influence of nanopatterned surfaces on bacterial adhesion. Although chitosan has some natural antibacterial properties, surfaces with different (laser induced) structures could modify bacterial proliferation. Antibacterial properties of chitosan could be enhanced by an incorporation of metallic nanoparticles, like silver.
We aim at a systematic investigation of the influence of different laser processing parameters on the generated structures on chitosan coated samples. Since the surface topography of any biomaterial affects cell mobility, a precise control of the formation of well-defined surface structures is crucial for optimal functionalization. Surface structures generated with ultrashort laser pulses at TUW will thus be characterized by means of SCA measurements, SEM and surface profilometry. Biocompatibility and toxicity tests of the laser structured biopolymer surface coatings will be conducted at FHCW as well as in vitro studies to evaluate adherence and directional growth of cells.

Expected Results:

- Optimized surface structures for enhanced cell growth
- minimized bacterial adhesion on laser treated surfaces to avoid biofilm formation

Participating Faculty: A. Otto (TUW), M. Raith (FHCW)
Associate Faculty Member S. Gruber (FHCW) will support the project with her expertise in biofilms and in the purification and preparation of chitosan

Planned lab rotations:
TU Wien: 36 months (ultra short pulse processing of biopolymer coatings, mechanical characterization, characterization of wetting behaviour)
FHCW: 12 months (studies on biocompatibility by means of testing toxicity and in vitro studies on cell growth and viability)