DocMASE Project Proposal 2013-04

Project Title	Tuning of drug release from Calcium Phosphate Materials
Main University and Advisor	Technical University of Catalonia (Spain) / Prof. Maria-Pau Ginebra and Cristina Canal
Second University and Advisor	Saarland University (Germany) / Prof. Frank Mücklich and Dr. Flavio Soldera
Associated Partner(s) (if applicable)	Fraunhofer Institute for Industrial Mathematics (ITWM) (Germany) / Dr. Katja Schladitz
Project Description (with **image**, if applicable)	In large bone defects, bone substitute materials must act as temporary scaffolds which facilitate the formation of new tissue and can be resorbed. An example of such materials are cements based on calcium phosphates (CaP), which have several advantages as they are potentially injectable and can set and harden in vivo at low temperature[1]. Calcium Phosphate Cements (CPCs) have a chemical composition similar to the bone, with specific nano/micro porosities[2]. Moreover, their simplicity in processing makes them extremely versatile and compatible with many techniques, allowing the fabrication of different macro-architectures. Achieving local drug delivery for an adequate period of time raises great interest and would provide benefits to the patient, such as reducing the number of drug administrations, thus conferring high added value to the materials. When dealing with calcium phosphate cements, which are non swellable – non erodible materials, drug release takes place by diffusion (and the rate of degradation can be considered much lower than the rate of drug release). In that case, modulation of the release of active principles can depend on the bonds established between the biomaterial and the drug. One of the main strategies in the project will be to introduce new functional groups on the calcium phosphates to alter the bonds with the drugs and achieved controlled drug release. It is expected that the new functional groups may alter different relevant properties of cements such as setting pH, or ion release, of high relevance towards the performance of the CPC biomaterials. In this work the new biomaterials and drug-delivery systems designed will be characterized at different levels, from the physic-chemical to cellular response to help bridging the gap between biomaterials science and improved hard and soft tissue therapies. An important aspect will be the 3D-characterization of porous structures using FIB/SEM tomography. The ITWM will support this characterization through appropriate software tools for the segmentation of these complex structures.
Previous Publications	• M.P. Ginebra, C. Canal, M. Espanol, D. Pastorino, E.B. Montúfar, *Adv. Drug Deliv. Rev*. 64 (12) *1090-1110* (2012) • M.P. Ginebra, A. Rilliard, E. Fernández, C. Elvira, J. San Román, J.A. Planell, Key Eng. Mat. 192-195 (2001) 781-784. • M.P. Ginebra, T. Traykova, J.A. Planell, Biomaterials. 27 (2006) 2171–2177. • J. Balach, F. Miguel, F. Soldera, D. Acevedo, F. Mücklich, C. Barbero, Journal of Microscopy, **246**(2012) , 3, 274-278.
References	[1] Ginebra M.P., Español M., Montufar E.B., Perez R.A., Mestres G., *Acta Biomater.* (2010) 6(8) 2863-2873. [2] M. Espanol, R.A. Perez, E.B. Montufar, C. Marichal, A. Sacco, M.P. Ginebra, *Acta Biomater*. (2009) 5, 2752-2762
Requirements of the candidates / Requirements during the doctoral programme (courses, seminars, etc.)	Very good English command. Knowledge of Spanish will be valued. Responsible, hard working. Bachelor in Materials Science, Chemistry, Physics or related disciplines. Master in Materials Science or related disciplines. 30 ECTS must been acquired during the program according to the minimum requirements of DocMASE.