◉ AR1 ○ AR2 ○ AR3	◉ Comunicación oral ○ Póster	☑ Opta a Premio

The potential of hybrids for bone regeneration, bioactivity biodegradation and cytotoxicity

D.A. Sánchez-Téllez[1,*], L. Téllez-Jurado[1], J.Rubio[2], A. Tamayo[2], L.M. Rodríguez-Lorenzo[3,4]

[1] Dept. Ing. Metalurg y Material. IPN--ESIQIE, UPALM-Zacatenco, Mexico City, 07738, Mexico
[2] ICV- CSIC, Kelsen 5, Madrid, 28049, Spain
[3] ICTP-CSIC, Juan de la Cierva 3, Madrid, 28006, Spain
[4]GBP, CIBER-BBN, Spain
* danielatellez06@gmail.com

Key words: Sol-gel; Hybrid material; Degradation kinetics; Apatite formation; Texture; Fractal

Introduction. Bioactive silica-based glasses, ceramics, and hybrids are called to play an important role as osteoproductive materials that induce quick bone regeneration[1.] Organic-inorganic hybrid materials based on SiO_2-modified PDMS-P_2O_5-CaO may be relevant in the field because they offer the capacity of tailoring properties[2]. The influence of the composition on the reaction kinetics, dissolution mechanism, obtained porosities, biodegradation, bioactive behavior, and cytotoxicity are studied in this work.

Methods. The hybrids were synthesized by a *sol-gel* method. The degradation and bioactivity of the hybrids were tested by soaking the specimens into SBF and PBS. The materials were characterized by FT-IR, XRD, MAS-NMR, TGA, and SEM. Raman spectroscopy, tensiometry and N_2 adsorption/desorption curves were used to measure the changes during degradation. Surface parameters, fractal constant and anisotropy of the pores were determined. Cytotoxicity assays were carried out using MG63 cells.

Results and Conclusions. SiO_2-modified PDMS-P_2O_5-CaO hybrids were synthesized and proven to be highly bioactive[3]. Degradation of the hybrids occurred simultaneously to the apatite growing and the apatite crystallization depends on the hybrid P_2O_5 content. As P_2O_5 content increased, the hybrids are denser and more stable. Hybrids with low-P_2O_5 presented a surface-driven degradation mechanism. Hybrids enriched in P_2O_5 showed a matrix dissolution process. During degradation, the surface parameters, fractal constant and anisotropy of the pores changed. The slight increase of the fractal constant in low-containing P_2O_5 materials suggested the formation of a homogeneous silica-like layer in the first stage of degradation, which also works as anchoring nucleus for subsequent apatite formation[4]. In all the cases, the degradation leads to ink-bottle shaped pores, increasing their volume as degradation occurs, but keeping their neck shape. Although the degradation products excreted during these processes, cellular viability was maintained over 70% at all the studied times.

References

1. L.M. Rodríguez-Lorenzo. In: Lafisco M, Delgado-López JM (eds) Apatite: synthesis, structural characterization and biomedical applications. NOVA publicshers, New York, 5. Pp 261-290
2. D.A. Sánchez-Téllez, et al. Optimization of the CaO and P_2O_5 content on PDMS-SiO_2-CaO-P_2O_5 hybrids intended for bone degradation. J. Mater Sci (2015) 50:5993-6006
3. A. Tamayo, et al. Surface properties of bioactive TEOS-PDMS-TiO2-CaO Ormosils. Journal of Materials Science (2014) 49:4656-4669
4. M.A. Mazo,et al. Stable highly porous silicon oxycarbide glasses from pre-ceramic hybrids. Journal of Materials Chemistry A (2015) 3:23220-23229

Acknowledgements. This work was supported by SIP-IPN 20140064 and 20150305 Project, Mexico. DGICYT Project, MAT2014-51918-C2-1-R, Spain. Fundación General CSIC (Programa ComFuturo) (A. Tamayo). CONACYT scholarship (D.A. Sánchez-Téllez).