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Biodegradabiliy of spherical mesoporous silica particles (MCM-41) in simulated body fluid (SBF)

Elena Boccardi[1], Anahì Philippart[1], Ana M. Beltrán[2,†], Jochen Schmidt[3], Liliana Liverani[1], Wolfgang Peukert[3], and Aldo R. Boccaccini[1,*]

[1]Institute of Biomaterials, Department of Materials Science and Engineering, University of Erlangen-Nuremberg, 91058 Erlangen, Germany
[2] Instituto de Ciencia de Materiales de Sevilla (CSIC-Universidad de Sevilla), 41092 Seville, Spain
[3]Institute of Particle Technology, Department of Chemical and Biological Engineering, University of Erlangen-Nuremberg, 91058 Erlangen, Germany

Abstract

Mesoporous silica particles of type MCM-41 (Mobile Composition of Matter No. 41), exhibiting highly ordered mesoporosity (pores with diameter between 2 and 50 nm) and surface roughness, are developed and used as a functional coating on bioactive glass-based scaffolds for bone tissue engineering. The degradability and the mesostructure stability of these novel MCM-41 particles were evaluated. The particles are immersed in simulated body fluid (SBF) for up to 28 days at 37 °C, and the variation of the ordered porosity, surface characteristics, and chemical composition of the particles are assessed by SEM-EDX, HRTEM, FTIR, ICP-OES, and pH measurements. The results indicate that the MCM-41 particles are affected by immersion in SBF only during the first few days; however, the surface and the mesopore structure of the particles do not change further with increasing time in SBF. The pore channel diameter increased slightly, confirming the stability of the developed material. The release of dissolved Si-species, which reached a maximum of 260 mg SiO_2 per gram of material, could play a key role in gene activation of osteoblast cells and in inducing new bone matrix formation.

Keywords: Mesoporous silica particles, Simulated body fluid, Biodegradability, Bone tissue engineering, Drug carriers; Biomaterials—Mineralogy Meets Medicine