Spectroscopic investigation of molecular self-assembly on bioactive glass particles

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Bioactive glasses attracted great attention for medical applications mainly in bone tissue repair [1], but also for soft tissue repair [2]. These applications are connected with their surface properties when exposed to biological or simulated biological environments.

Structural changes occurred at the interface of bioactive glass particles with simulated body fluids (SBF) were investigated by several techniques including infrared spectroscopy and magic angle spinning nuclear magnetic resonance (MAS-NMR). The $^{29}$Si and $^{31}$P MAS-NMR results show that silicate species with two and three bridging-oxygens per SiO$_4$ tetrahedra and PO$_4$ monomeric units dominate the structure of the investigated samples. The peak deconvolution and data analysis of the NMR data were performed with DMFit program [3].

After immersion in SBF new Q$_4$ silicate species with four bridging oxygens appear as result of silica-gel layer formed on microspheres surface (Fig. 1).

Fig. 1. $^{29}$Si MAS-NMR spectra of bioactive glass particles before (a) and after immersion (b) in SBF.

The self-assembly of crystalline hydroxyapatite type layer is reflected by the occurrence of narrow components in 31P MAS-NMR spectra.

Keywords: bioactive glass particles; molecular self-assembly; MAS-NMR.

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References