Albumin and fibronectin attachment on silicate and phosphate bioactive glasses

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Abstract

Phosphate glasses within the composition 50P2O5-20CaO-20SrO-10Na2O (Sr50) react in biological media and form a dicalcium phosphate di-hydrate layer at their surface. Cell test was performed on these glasses using two cell types: human gingival fibroblasts and human adipose stem cells. While the fibroblasts attached and proliferated at the glass surface (at a slower rate than on typical bioactive glasses), the stem cells only proliferated near the glass. Therefore, the dissolution by-products were appropriate for the proliferation of cells but the glass surface does not act as a good substrate for cell adhesion. However, cells, in-vivo, do not interact with the surface of the biomaterial but rather with a dynamic protein (mono)layer adsorbed at the implant surface. Therefore, to understand the cell attachment and enhance the glass's ability to promote cell adhesion, their surface chemistry was studied. Understanding the glass surface chemistry can allow for developing suitable surface modifications, which will enable superior protein adsorption. In this context, the glass Sr50 as well as Sr50 doped with Cu, Ag and Fe (to tailor the dissolution rate) were studied. The glasses were washed using basic, neutral and acid buffer solutions before silanization. Two types of proteins (albumin and fibronectin) were deposited at the sample surface. The impact of surface treatment on the glass surface chemistry was studied with contact angle measurement, FTIR and zeta-potential. The protein adsorption was assessed by fluorescence microscopy. All tests were also conducted on silicate bioactive glasses, used as reference. Washing improved protein adsorption. And while the acidic wash was best suited to the adsorption of albumin, basic wash was optimum for the adsorption of fibronectin. The silanization further increased the protein adsorption. The impact of surface modification on cell attachment was studied using fibroblasts cultured for 24h and imaged with an integrated live imaging system.

Keywords: bioactive glass, phosphate glass, protein adhesion, cell adhesion

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