Structure and Dissolution Behaviour of Multifunctional Borophosphate Bioactive Glasses

Arun Krishnamurthy*[1], Jordan Perillo[1], and Scott Kroeker†[1]

[1]Department of Chemistry, University of Manitoba – Winnipeg, Manitoba, Canada

Abstract

Glass has become a widely used and extensively studied biomaterial for bone regeneration, soft tissue repair and dental applications. The chemical durability requirements well known for bone growth are relaxed for wound-healing applications, where glass dissolution is essential for efficacy. We have explored the structure and dissolution properties of a series of low-durability borophosphate glasses doped with ions thought to have therapeutic properties, such as silver for antibacterial effects, and zinc for angiogenesis and enhanced nerve regeneration. Glass network formers boron and phosphorus disintegrate to aid in the expression of matrix protein and the vascularization process, respectively. Multinuclear magnetic resonance (NMR) spectroscopy of the glasses before and after dissolution confirms congruent dissolution in most compositions, as implied by leachate analysis, and reveals the formation of secondary crystalline phases at the highest boron concentrations. Morphological alterations are visualized using scanning-electron microscopy. The dissolution behaviour is correlated with structural features such as cation coordination number and connectivity, as measured by NMR spectroscopy.

Keywords: NMR, borate, phosphate, biomaterials, dissolution

*Speaker

†Corresponding author: scott.kroeker@umanitoba.ca