Following phosphate glass dissolution by P-31 NMR

Delia S. Brauer1,*, Dahiana A. Avila Salazar1 & Peter Bellstedt2

1Otto Schott Institute of Materials Research, Friedrich Schiller University Jena, Fraunhoferstr. 6, 07743 Jena, Germany
2Institute of Organic and Macromolecular Chemistry, Friedrich Schiller University Jena, Humboldtstr. 10, 07743 Jena, Germany

Abstract

Phosphate glasses are of interest for a wide range of applications, including radioactive waste entrapment materials, laser glasses, fertilisers in agriculture or resorbable biomaterials. They are water soluble, and controlling their rate of degradation and dissolution is key for all these applications. The mechanism by which phosphate glasses dissolve differs significantly from that of silicate glasses and includes hydrolysis of P—O—P bonds and hydration of entire chains. However, there are several points which are still under debate. This talk looks into different approaches for characterising phosphate glass dissolution mechanisms, starting with the early studies from the 1950’s and including titration and chromatography studies. In addition, our recent results comparing structural units in glass and aqueous solution (Figure 1) by solid state and solution P-31 nuclear magnetic resonance spectroscopy will be presented.

Figure 1: (a) 31P NMR spectra showing changes in the relative concentration of structural (Qn) groups in solution during phosphate glass dissolution. (b) Connectivity between phosphate groups after dissolution
Brief Biographical Notes

Delia S. Brauer is professor for bioactive glasses at the Otto Schott Institute, University of Jena, Germany. After finishing her studies in environmental chemistry she completed her PhD on phosphate glasses at the University of Jena. She worked as a postdoctoral researcher at the University of California, San Francisco, Nagoya Institute of Technology, Japan, and Imperial College and Queen Mary University of London, UK, before returning to Jena as a junior professor in 2012. In 2017 she was promoted to full professor. Her research focuses on the structure-property relationship in glasses, with a focus on degradable and highly disrupted glass systems including phosphate glasses and phospho-silicate glasses. She is a member of Technical Committee 04 (Bioglasses) of the International Commission on Glass, member of the Basic Sciences and Technology Committee of the Society of Glass Technology, Associate Editor of a new journal "Biomedical Glasses", Fellow of the Society of Glass Technology and winner of the Gottardi Prize of the ICG in 2015.