Dissolution Kinetics of Oxide Glasses

Effect of Network Topology

Mascaraque Alvarez, Nerea; Bauchy, Mathieu; Smedskjær, Morten Mattrup

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Dissolution Kinetics of Oxide Glasses: Effect of Network Topology

Nerea Mascaraque[1], Mathieu Bauchy[2], Morten M. Smedskjaer[1,*]

[1]*Department of Chemistry and Bioscience, Aalborg University, Fredrik Bajers Vej 7H, Aalborg 9220, Denmark*

[2]*Department of Civil and Environmental Engineering, University of California, Los Angeles, California 90095, USA*

Abstract

Oxide glasses gradually dissolve and corrode when they are exposed to aqueous solutions, limiting the scope of their applications. In a recent study focusing on silicate minerals and glasses, a direct relation was demonstrated between the dissolution rate at high pH and the number of chemical topological constraints per atom (n_c) acting within the molecular network. Here, we extend this work by studying the dissolution kinetics of seven oxide glasses with different network former and intermediate cations through measurements of weight loss of bulk samples immersed in acid (pH = 2 and 4), neutral (pH = 7), and basic (pH = 10 and 14) solutions. A direct relationship between their chemical durability and the network topology has been found. Our study of chemical dissolution also allows establishing the kinetic mechanisms depending on pH and glass topology. Thus, with this research and existing topological models, the atomistic design of new oxide glasses with a specific chemical durability for a determined pH becomes possible, e.g., novel bioactive glasses with tailored dissolution kinetics.