Preface

Solid electrolytes are important components of all-solid-state devices of energy storage and conversion. A prerequisite for such applications is a knowledge about ion transport in the device materials. The present volume contains a series of five chapters by experienced authors from the field of diffusion and ionic conduction. The chapters are devoted to various aspects of ion transport in compounds and glasses studied by theoretical and experimental methods.

An early prototype of a solid electrolyte is alpha silver iodide discovered already in 1914. This discovery triggered the development of a new field of research, which is nowadays called solid state ionics. Alpha silver iodide stands out among solid electrolytes as an archetypical fast ion conductor. The progress made in the understanding of alpha silver iodide during the last decades is reviewed in chapter 1 of this volume by *Funke*. This chapter also includes very recent result about low temperature alpha silver iodide, which was obtained by quenching. It provides deep insight in the ionic jump processes of Ag ions in alpha silver iodide.

Interdiffusion in binary metallic alloy systems is a well-known topic. The interdiffusion coefficient in alloys is related to the tracer diffusivities of the two components and the thermodynamic factor via the Darken-Manning equation. This equation is, however, not applicable to ionic compounds with anion and cation sublattices. In chapter 2 *Belova and Murch* review the Nernst-Planck equation, which relates interdiffusion of two types of cations in the cation sublattice with the two cation tracer diffusivities and the thermodynamic factor. This knowledge is a prerequisite for a deeper understanding of interdiffusion in ionic compounds.

Chapter 3 by *Mehrer* reviews knowledge about cation conduction and diffusion in soda-lime silicate glasses and alkali oxide glasses. In these glasses network formers are oxides of silicon and boron and the network modifiers are alkali ions. The ionic conductivity is due to the motion of alkali ions. Effects of the total alkali content, the relative content of two different alkali ions in mixed glasses, temperature and also pressure are investigated. The mixed-alkali effect manifests itself by a deep minimum of the ionic conductivity and a crossover of the tracer diffusivities of the two components. By comparison of tracer diffusion and ionic conductivity the Haven ratio is obtained. It is unity for low alkali contents and decreases with increasing alkali concentration. This decrease can be attributed to an increasing degree of collectivity of alkali ion jumps..

Chapter 4 by *Weitzel* describes a recently developed novel technique of bombardment induced ion transport. It can be used to study transport in ion-conducting glasses. The attachment of alkali ions to the sample surface builds a surface potential and a density gradient. The associated gradients induce ion transport to a metal electrode which detects the neutralization current. Bombardment with native ions provides access to ionic conductivities and can compete with impedance spectroscopy in particular at low conductivities.

Chapter 5 by *Eckert* is devoted to the network former mixing effect. In many glass systems network former mixing results in nonlinear variations of physical properties including the ionic conductivity. The structure-property correlations are studied in this chapter besides by Raman and X-ray photoelectron spectroscopy mainly by solid-state nuclear magnetic resonance (NMR). A particular focus is on the characterization of network-former mixing effects in lithium and sodium conducting oxide and chalcogenide glasses. Network former mixing in ion-conducting glasses can be used to optimize solid electrolyte properties.

Chapter 1
Making the Centennial of the Discovery of Alpha Silver Iodide
K. Funke (43 pages)

Chapter 2
Interdiffusion in Ionic Compounds
I.V. Belova, G.E. Murch. (18 pages)

Chapter 3
Diffiusion and Ion Conduction in Cation-conducting Oxide Glasses
H. Mehrer (50 pages)

Chapter 4
Bombardment induced Ion Transport through Ion-Conducting Glasses
K.-M. Weitzel (39 pages)

Chapter 5
Network Former Mixing (NFM) Effects in Ion-Conducting Glasses. Structure/Property Correlations studied by Modern Solid-State NMR Techniques
H. Eckert (51 pages)