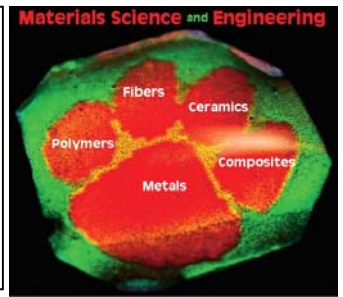


Seminar Series

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Synthesis, Structure, and Ionic Conductivity of $\text{Li}_2\text{S} + \text{GeS}_2 + \text{GeO}_2$ Oxy-sulfide Glasses

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Lithium oxy-sulfide glasses, such as the $\text{Li}_2\text{S} + \text{SiS}_2$ (or $\text{Li}_2\text{S} + \text{GeS}_2$) + Li_xMO_y ($\text{Li}_x\text{MO}_y = \text{Li}_3\text{PO}_4, \text{Li}_4\text{SiO}_4, \text{Li}_3\text{BO}_3, \text{Li}_4\text{GeO}_4$) have been considered as the best solid electrolyte for rechargeable lithium batteries due to their high ionic conductivity of $\sim 10^{-3}$ (S/cm) at 25 C and chemical stability toward Li metal anode. However, only a few glass compositions have been synthesized and their structures have not been thoroughly studied. In addition, it is still not clear whether an increase in the conductivity of Li_xMO_y doped glasses is the result of increasing lithium concentrations or the formation of favorable structures for conductivity in the glass matrix.

In this work, GeO_2 was added systematically to the binary $\text{Li}_2\text{S} + \text{GeS}_2$ glass system and their structural changes have been analyzed using IR and Raman spectra spectroscopy. Additions of GeO_2 to binary $\text{Li}_2\text{S} + \text{GeS}_2$ glasses, which consist of bridging (Ge-S-Ge) and non-bridging (Ge-S-) sulfurs, increase the bridging oxygen band (Ge-O-Ge) at the expense of decreasing the bridging sulfur band (Ge-S-Ge), whereas the bands associated with the non-bridging sulfurs (Ge-S-) remain constant in intensity up to high GeO_2 concentrations. From these observations, the structural groups in the $\text{Li}_2\text{S} + \text{GeS}_2 + \text{GeO}_2$ glasses were described and were used to develop a structural model of these glasses. The ionic conductivities of this glass system were also investigated and the relation between the glass structures and ionic conductivities have been examined.

Biographic Sketch

Dr. Steve Martin received his B.A. in Chemistry from Capital University in Columbus, Ohio in 1980 and then earned the Ph.D. in Physical Chemistry from Purdue University with 1986. Dr. Martin then joined the faculty at Iowa State University and was promoted to Associate Professor in 1990, Professor in 1995, and now holds the position of University Professor in the Department of Materials Science and Engineering. Prof. Martin's research interests include glass formation, processing, structure, properties and dynamics; ionic transport; relaxations in glass; the liquid-glass transition; chemical restructuring processes in liquids and glasses; new solid glassy electrolytes for lithium batteries; fast proton conducting membranes for H_2 - O_2 fuel cells.

Dr. Martin has published over 150 publications and has received numerous honors and awards. These include the serving as the 175th Jubilee Professor in the Department of Applied Physics at Chalmers University of Technology, Göteborg, Sweden (2004), the Faculty Recognition for Teaching Award, ISU Honors Program (2003), Fellow of the American Ceramic Society (2002), a Research Development Corporation R&D 100 Award, (1995). Dr. Martin also has been chair of numerous professional committees and conferences.