Department of Materials Science and Engineering
635:416   Physical and Chemical Properties of Glass

Course Instructor:

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Term:

Spring Semester

Office Hours:

Tuesday, Thursday, 3:00pm-4:00pm. (also, off hours whenever I'm available)

Course Catalog Description:

Provide students with an atomistic understanding of the role of composition on the structure and properties of glasses.

Prerequisites:

Glass Engineering
Thermodynamics

Texts:

Recommended Reference Texts:

The Physical Properties of Glass, D. G. Holloway
Chemistry of Glasses, A. Paul
Inorganic Glass Forming Systems, H. Rawson
Introduction to the Physical Chemistry of the Vitreous State, P. Balta and E. Balta

Original papers plus various chapters of each of the recommended texts are used to augment the classroom discussions.

Course Objectives:

Course is designed to introduce undergraduate seniors to the atomistic behavior affecting the structure and properties of glasses and glass surfaces. More importantly, lectures and student participation are designed to make students think about the various atomistic mechanisms that can be used to explain the macroscopic behavior of glasses that they had learned in previous courses. Therefore, significant class participation is required.

Topics:

1. Nature of the glassy state
2. Glass formation and the glass transition
   (Structural, Thermodynamic, and Kinetic effects on T_g)
3. Structure of oxide glasses (based on: RDF's, Spectroscopies, Molecular Diffusion, Simulations)
   a) SiO_2
   b) R_2O SiO_2
   c) Complex multicomponent silicates
4. Effects of composition on structural and dynamic properties
5. Fracture behavior
6. Structure of glass surfaces
7. Diffusion in glass and on surfaces

8. Durability and corrosion behavior
9. Amorphous solids in confined spaces.

Schedule:
Class meets 2 times per week for 80 min each class.

Grading:
Two exams, tests, and significant class participation.

Contribution To Professional Component:

Molecular mechanisms governing the behavior of materials (specifically glasses here) are often inferred from experimental data. Small system sizes, such as in nanomaterials, require greater understanding of mechanistic behavior at the atomistic level. Computational techniques associated with experiments are becoming more prevalent and this course provides students with an understanding of macroscopic behavior described in atomistic terms.

Relation To Program Objectives:
Course relates to overall ABET objectives, enhances student inquisitiveness, and is the only course that provides a detailed atomistic description of behavior in glasses. Meets Program Outcomes a, b, f, g, i, j, l.