

Department of Materials Science and Engineering
CER E 414 Ceramic Engineering
Electrical Properties of Ceramics (3 credits)

Catalog Description:

This course covers a broad scope of the electrical properties of ceramics: ionic conductivity, dielectricity, piezoelectricity, ferroelectricity, magnetism, etc. These properties are based on distinct fundamentals: defect chemistry (ionic conductor), forced polarization (dielectrics), spontaneous polarization (ferroelectrics), and electron spin (magnetism). Offered: Winter.

Prerequisites:

Crystallography (MSE 316) and general electrical properties (EE 250)
Concurrent registrations required in CerE 415

Textbook:

A.J. Moulson and J.M. Herbert (1990), Electroceramics, Chapman & Hall, London, (Optional).

Course Objectives:

1. Analyze the electron-optical-magnetic properties using fundamentals of crystallography and microstructure.
2. Design and improve the electrical properties of ceramics with a fundamental approach.
3. Evaluate the electrical properties and recommend the approaches for improvement.

Topics Covered:

Ceramic Conductors and Insulators
Point defects and defect chemistry
Brouwer diagrams
Ionic and mixed conduction
Dielectrics and Capacitors
Charge displacement
Dielectrics in static and alternating electric fields
Dielectric strength
Ferroelectrics
Spontaneous polarization
Prototype ferroelectric: BaTiO₃
Domains and Curie temperature
E-P hysteresis
Piezoelectric Ceramics
Symmetry consideration
Basic relationships
Electro-optic Ceramics
Pyroelectric Ceramics

Magnetic (ferrite) Ceramics
Basic concepts
Weiss domains and Curie temperature
B-H hysteresis and model ferrites
Ceramic Superconductor

Class Schedule:

Three 50 minute sessions weekly

Contribution of course to meeting the professional component:

This course provides students with an integrated fundamental understanding of electrical properties of ceramics and the relationships between chemical composition, structure, and properties of ceramic materials. This course focuses on applications of electronic ceramics as related to their properties, structure and processing.

Contribution of the course to program objectives:

This course uses the student's knowledge of advanced science to focus on electronic properties and applications of ceramic materials

Prepared by: Guozhong Cao, Assistant Professor, September 22, 2000