



UNIVERSITY OF  
BIRMINGHAM

<b>Module Name:</b>	<b>Functional Materials</b>
<b>Module Code:</b>	<b>04 18511</b>
<b>Presenter(s):</b>	<b>Professor Tim Button (Co-ordinator), Dr Adrian Crisan, Dr Allan Walton</b>
<b>Credit Rating:</b>	<b>10</b>
<b>Venue:</b>	<b>School of Metallurgy &amp; Materials, University of Birmingham</b>

#### **Description:**

The module will introduce the important role played by functional materials in a wide range of application areas including energy, communications, and transport. Materials to be studied will encompass a selection from ferroelectric, piezoelectric and dielectric ceramics; ionic and electronic conducting ceramics; semiconductors; magnetic, superconducting and magnetostrictive materials.

The important underlying scientific concepts for each material and application area will be elucidated. A number of key technologically important applications such as fuel cells, solar cells, and optical and magnetic data storage media will be studied in detail. The transport area will include the role of magnets and superconductors in magnetic levitation (maglev), and magnets, magnetostrictives and piezoelectrics for automobile applications. Functional ceramic materials will be introduced for a range of communication and environmental monitoring applications. In each case fabrication and processing routes appropriate for each group of materials in the particular application area or device will be introduced and the important links between processing, microstructure and properties will be quantified. The range of applications will require detailed exploration of thin film, thick film, bulk and fibre processing routes, and exploration of specialised fabrication routes for magnetic, superconductor and functional ceramic materials.

#### **Learning Outcomes:**

By the end of the module the student should be able to:

- appreciate and describe the wide use of functional materials in a range of technologically important application areas
- understand key concepts of magnetic, dielectric, ferroelectric, piezoelectric and superconducting materials relevant to their use in Engineering applications
- Describe general fabrication processes relevant to ceramic and powder-based materials
- Understand and quantify process-microstructure-property relationships in a range of functional materials applications
- describe specialist materials fabrication routes for specific properties and applications.

**Module Aims:**

To provide an introduction to the concepts, fabrication, properties and applications of technologically important functional materials.

**Syllabus:**

- Applications of Functional Materials
- Advanced Electroceramics ó Introduction, Concepts, Materials, processing and Properties.
- Superconducting Materials ó Introduction, Concepts, Materials, processing and Properties.
- Advanced Magnetic Materials ó Introduction, Concepts, Materials, processing and Properties.
- Current and emerging themes in functional materials research.

**Assessment:**

Two hour open book examination at end of course presentation. Presentation during course. 2,000 word essay to be submitted within five weeks following course presentation.