School of Chemistry

Aims and Objectives: Session 2022-2023

Module CH4715: Functional Materials and Electrons in Solids

Course Title: Functional Materials and Electrons in Solids

Duration: 20 hours

Lecturer: Professor M. Buck and Professor F. D. Morrison*

(*Module Convenor)

Aims: Mobile phones, personal computers, air bags, solar cells: our modern society would not exist without the diversity of properties of dielectrics, semiconductors, and metals. The principal aim of the course is to understand the reasons why some materials conduct electrons and why others do not. Topics include electronic conductivity in elemental, compound, oxide, and organic semiconductors, spin properties of electrons in solids, and bulk and interfacial properties of inorganic and organic materials.

Objectives:

1. To understand the general electronic properties of solids in terms of different models based on the localised and delocalised description of charge carriers. Depending on the state of the materials band type or hopping conduction determine the electrical properties. Furthermore, these will be affected by interactions between the charge carriers, chemical bonding or lattice vibrations.

2. To understand the characteristics of intrinsic and extrinsic semiconductors, semiconductor junctions, and the (opto)-electronic properties of organic semiconductors.

3. To understand mechanisms for modifying the properties of functional materials; this includes influence of defect chemistry and doping (compositional modification). To appreciate the role of synthesis conditions, particularly partial pressure of oxygen, on the properties of functional oxides.

4. To understand basic materials selection criteria and basic operating principles for commercial devices including: magnetic, ferroelectric, phase change and multiferroic materials for non-volatile memories, piezo- and pyroelectric devices, microwave dielectric resonators for mobile phones, thermistors and varistors, multilayer ceramic capacitors.