MONASH University
Centre for Electron Microscopy

SEMINAR

Interfaces in fuel cells, solar cells and biomaterials

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11am – 12noon
Science Lecture Theatre S6, Building 24

Abstract

Electron energy-loss spectroscopy (EELS) when performed in the scanning transmission electron microscope (STEM) is, arguably, the only technique that can provide information of chemistry and bonding in solid materials with near atomic scale spatial resolution. Recent developments in energy-dispersive X-ray (EDX) analysis have resulted in a paradigm shift – rapid elemental mapping of light elements with atomic scale spatial resolution is now possible. In this lecture I will discuss the possibilities and limitations of state-of-the-art analytical electron microscopes, with particular emphasis on the potential for study of complex interfaces.

The search for new strategies to enhance the oxide ionic conductivity in oxide materials is an active field of research. Such materials are needed for application in a new generation of more efficient and durable solid state electrochemical devices such as reduced-temperature Solid Oxide Fuel Cells (SOFCs). There have been numerous reports in the literature of significantly enhanced ionic conductivity in multilayer heterostructures formed from ionic conductors and insulators. There have also been a number of reports suggesting that these enhancements are due to electronic rather than ionic conductivity. I will discuss recent results from STEM-EELS-EDX studies where we have probed the structure, composition and bonding with high spatial resolution in order to relate the interfacial structure and chemistry to the observed conductivity.

Applying STEM-EELS to the study of interfaces in organic, hybrid and biomaterials system is complicated by many factors. I will discuss the insights that can be gained into the structure-property relationships in mineralised tissue, inorganic wear debris in periprosthetic tissue and organic solar cells. The common aspect in all of these studies is the need to probe hard/soft or soft/soft interfaces between inorganic and organic materials. This presents considerable challenges associated with sample preparation, electron beam damage and achievable spatial resolution. I will show that it is possible in many cases to obtain both qualitative and quantitative chemical information that can significantly enhance our understanding in these complex systems.

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