Monash Centre for Electron Microscopy Seminar

Energy Loss Spectroscopy at High Resolution: Applications to Functional Materials and Plasmonic Nanostructures

MONDAY 17 SEPTEMBER, 2018

11.00AM

LECTURE THEATRE S11
16 RAINFOREST WALK
MONASH CLAYTON CAMPUS

Presenter

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ABSTRACT

Electron energy loss spectroscopy (EELS) is an invaluable technique to study the detailed structure and the chemical state of materials at unprecedented spatial resolution. Today, this technique is used "routinely" to characterize nanoscale materials used in a myriad of applications from energy storage and conversion, to solid-state devices and biomaterials interfaces. This technique also has the potential to provide insight into much more fundamental problems where the valence state of atoms and their location is of fundamental importance.

In this presentation, I describe recent developments in electron energy loss spectroscopy to probe the changes in bonding and coordination of atoms using quantitative measurements of the energy loss spectra [1,2]. I will show that, with atomic resolved EELS, it is possible to determine ordering of cations in oxides [3] and changes in bonding at interfaces, consistent with modifications in the coordination of interface atoms. I will highlight how atomic resolved experiments with EELS can be used to systematically study the local valence in high-T superconductors [4], and to even extract the localized hole concentration in superconducting chain-ladder compounds [5]. In the area of Li battery materials, I will highlight a detailed study of the structure and evolution of "NMC"-type materials following electrochemical cycling to demonstrate the potential of EELS to understand the fundamental behavior of industrially relevant materials [6]. The benefits of using a spectrometer fitted with a direct electron detector for EELS will be shown. Finally, some highlights of detailed studies of the plasmonic response of simple and very complex metallic nanostructures will be shown [7].

About the Canadian Centre for Electron Microscopy:

The Canadian Centre for Electron Microscopy, located at McMaster University, is one of the CFI-Major Science Initiative National Facilities. The CCEM provides world-class electron microscopy capabilities and expertise to Canadian researchers and industry working in a broad range of fields. A brief introduction about the CCEM, its user base and infrastructure will be given.
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[1] G.Z. Zhu, et al. Nature, 490, 384, (2012) [2] M. Bugnet, et al., Phys. Rev. B 88, 201107(R) (2013), and Phys Rev. B, 93, 020102 (2016) [3] S. Turner, et al., Chem. Mater. 24, 1904-1909 (2012)
[4] N. Gauquelin, et al., Nature Communications 5, 4275 (2014) [5] M. Bugnet, et al., Science Advances 2016; 2:e1501652 (2016). [6] H. S. Liu et al. Physical Chemistry Chemical Physics 18, 29064-29075. (2016) and H. Liu et al, ACS Nano, 12 (3), pp 2708–2718 (2018) DOI: 10.1021/acsnano.7b08945
[7] D. Rossouw, et al., Nano Letters 11, 1499-1504 (2011); D. Rossouw, G.A. Botton, Phys. Rev. Letters 110, 066801 (2013); S. J. Barrow et al, Nano Letters 14, 3799-3808. (2014); EP Bellido, et al., ACS Photonics, 3, 428-433 (2016), and ACS Photonics, 4, 1558-1565 (2017); E.P. Bellido, et al., Self-similarity of plasmon edge modes on Koch fractal antennas, ACS Nano, DOI: 10.1021/acsnano.7b05554), (2017).

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