

NanoLab Talk

Monday, 28th may, 2018 – 14.30

Seminar Room 1° floor

Department of Energy – Cesnef (Building 19) via Ponzio 34/3 Milan
Politecnico di Milano

“High-Resolution Electron Microscopy and Spectroscopy: Applications to Energy-related Materials and Devices”

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Abstract:

Transmission electron microscopy is an invaluable technique to study the detailed structure of materials at unprecedented spatial resolution. Beyond imaging, this technique, when combined with analytical methods such as energy dispersive and electron energy loss spectroscopies, provides information on the chemical composition, chemical state and localized strain in a broad range of materials. The versatility of an electron microscope makes it possible to provide useful information related to both industrially relevant materials and the most fundamental questions in quantum materials.

In this presentation, I describe recent developments in electron microscopy showing applications related to catalysis materials used in fuel cells and energy storage materials used in batteries in order understand their structure and evolution following operation. I will show some examples of detailed studies of the plasmonic response metallic nanostructures demonstrating that it is possible to probe details of surface plasmon resonances with much higher spatial resolution than ever possible. Examples will also include measurement of strain and atomic resolved composition in semiconducting materials and in-situ electrochemistry directly in the transmission electron microscope.

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About the Speaker

Gianluigi Botton received a degree in Engineering Physics and a PhD in Materials Engineering at Ecole Polytechnique of Montreal. He was Postdoctoral Fellow in the Department of Materials Science and Metallurgy at the University of Cambridge from 1993 to 1998. He joined the Materials Technology Laboratory of Natural Resources Canada (NRCan) in 1998 as a research scientist. In 2001 he moved to the Department of Materials Science and Engineering at McMaster University where he holds a Tier 1 Canada Research Chair in Electron Microscopy of Nanoscale Materials. He is recipient of the 2017 Faculty of Engineering Research Achievement Award at McMaster University. He received the Metal Physics Medal of the Canadian Materials Science Conference in 2017. He is Fellow of the Microscopy Society of America, he received the Brian Ives Lectureship of the ASM in 2009, the CAMBR Lectureship at Western University in 2013 and the NABMM Scientific Merit Award at NRCan. Prof. Botton established, and currently leads, the Canadian Centre for Electron Microscopy a national facility for ultrahigh-resolution microscopy. He was President of the Microscopical Society of Canada and he is on the Editorial Board of “Materials Today-Nano” an Elsevier Journal, he is Editor of *Microscopy*, and on the editorial board of *Micron*, two international journals dedicated the development and application of microscopy methods. In 2005 and 2015 he organised the Canadian Microscopy Society annual meetings. In 2007, he organised the Canadian Materials Science Conference at McMaster University, and in 2019 and 2013 the international EELS meeting.

Three representative publications:

1. Zhu, G. Z.; Radtke, G.; Botton, G. A., Bonding and structure of a reconstructed (001) surface of SrTiO₃ from TEM. *Nature* **2012**, *490* (7420), 384-387.
2. Rossouw, D.; Couillard, M.; Vickery, J.; Kumacheva, E.; Botton, G. A., Multipolar Plasmonic Resonances in Silver Nanowire Antennas Imaged with a Subnanometer Electron Probe. *Nano Letters* **2011**, *11* (4), 1499-1504;
3. M. Bugnet; Loffler, S.; Hawthorn, D.; Dabkowska, H. A.; Luke, G. M.; Schattschneider, P.; Sawatzky, G. A.; Radtke, G.; Botton, G. A., Real-space localization and quantification of hole distribution in chain-ladder Sr₃Ca₁₁Cu₂₄O₄₁ superconductor, *Science Advances* **2**, UNSP e1501652. (2016)

Website: <https://www.bottonsgroup.com>

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. A brief introduction about the CCEM, its user base and infrastructure will be given.

<https://ccem.mcmaster.ca/>