Using Electrons and Photons for Materials Characterization: Using the Best of Both Worlds

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Materials characterization is a key component of the materials innovation cycle. New tools are now available to discover the crystalline structure, composition, chemical bond and arrangement of atom with electron beams smaller than 1Å. While physicists, chemists and materials scientists benefit tremendously from these improvements, we need to be mindful of the fact that there are many other tools that provide complementary information and that there are limitations to all techniques. In this presentation, I will show some recent examples of state-of-the-art electron microscopy work related to battery materials, plasmonic nanostructures and the detection of phonon excitations in crystals. Then I will focus on complementary photon-based techniques that are available at the Canadian Light Source synchrotron. With photon energies ranging from sub-meV to over 100keV, there is a wealth of information that can be extracted from imaging, spectroscopy and scattering methods, from bonding environments of catalysts and the electronic structure of surfaces, to imaging of cochlear implants, spectroscopy *in-operando* conditions and trace contaminants in living tissues. These examples highlight the benefits of considering multiple techniques when one needs to understand the structure and composition of a very broad range of samples.

Gianluigi Botton, Brief Bio.

Gianluigi Botton received a degree in Engineering Physics and a PhD in Materials Engineering from Ecole Polytechnique of Montréal. 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 received the Metal Physics Medal of the Canadian Materials Science Conference (2017), the Lee Hsun Research Award from the Institute Metals Research of the Chinese Academy of Sciences (2017), the Microbeam Analysis Society Presidential Award (2020) and he is Fellow of the Microscopy Society of America and Fellow of the Royal Society of Canada. Prof. Botton established the Canadian Centre for Electron Microscopy-CCEM, a national facility for ultrahigh-resolution microscopy, and was its director for over 11 years. In May 2019, he became the Science Director at the Canadian Light Source, Canada's synchrotron while he continues to hold is academic appointment and his research at McMaster University. In his academic role at McMaster, Prof. Botton has established an impressive research record, having secured more than $50M in funding as Principal Investigator and $90M as a co-investigator, with more than 350 peer-reviewed publications and over 50 highly qualified personnel trained in his group.