MONASH University

Monash Centre for Electron Microscopy

Monash Centre for Electron Microscopy Seminar

Combining high temperature and gas within the environmental TEM: towards operando analysis of nanocatalysts

Wednesday 19 September, 2018

3.00pm – 4.00pm

Lecture Theatre S2, 16 Rainforest Walk, Monash University Clayton Campus

Presenter

Dr Matthieu Bugnet
CNRS – University of Lyon

ABSTRACT

Transmission electron microscopy (TEM) is a well-established characterization technique to combine bulk as well as surface analysis in a wide range of materials at the nanoscale. Since most materials are usually not operated under moderate or high vacuum, investigating them in situ in the TEM in more realistic environmental conditions appears necessary to understand fundamental structural and chemical aspects at surfaces in several fields of research such as catalysis, corrosion, or crystal growth. In this respect, control of the nature and pressure of the atmosphere surrounding the specimen, while allowing nanoscale down to atomic resolution analysis in a TEM is of great importance.

Surface phenomena observed on individual nanoparticles, and induced by the partial pressure and temperature within a dedicated Cs-corrected environmental TEM (ETEM), will be presented, with a focus on heterogeneous catalysis applications. CeO2 is a fundamentally interesting and technologically important catalyst and catalyst support. With a strong tendency to be reduced under the electron beam, CeO2 is a challenging material in a high vacuum TEM column, and offers a perfect field of play for redox state control in the ETEM. Beyond tuning the redox state, a complete understanding of the surface atomic structure and atomic mobility of catalytically active surfaces is of primary importance in terms of surface reactivity. The direct visualization of the atomic scale mobility at {100} surfaces of CeO2 in the environmental TEM (ETEM), and its application to the adsorption/desorption phenomena of carbonates will be shown [1]. The microscopy group at the University of Lyon also works on the development of fast electron tomography for beam sensitive materials and dynamic studies under environmental conditions [2]. Recent examples will be presented, such as the combustion of soot by zirconia, allowing the activation energy of the soot combustion to be evaluated.

[1] M. Bugnet et al., Nano Letters 17 (12), 7652 (2017).
[2] L. Roiban et al., J. of Microscopy, 269 (2), 117¬ (2018).

ABOUT THE PRESENTER

Matthieu Bugnet graduated from the University of Poitiers, France, in 2011. He was a postdoctoral fellow then research associate in the group of Gianluigi Botton at McMaster University, Canada. Since 2016, he holds a CNRS position at the University of Lyon, France. His research activities revolve around the use of electron energy-loss spectroscopy (EELS) in the aberration-corrected STEM, more specifically to understand chemical bonding in nanoscale materials via the interpretation of near-edge structures at sub-nm spatial resolution. Recently, he started investigating high-temperature and gas-induced phenomena in the environmental TEM, using EELS and high resolution TEM

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