MSE-Colloquium@NTU

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Lecture Theatre 6, Nanyang Technological University

In Situ and Environmental Electron Microscopy Studies of Material Reactions, at the Atomic Level

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About the Talk

There has been a steady growth in the applications and breadth of in situ transmission electron microscopy (TEM) since the 1980's [1]. At that time, the procedures to carry out meaningful experiments were described [2] but it was thought that high voltage TEM and thick specimens were required to reproduce bulk behavior. However, in a series of studies, we established that this was not necessarily the case and that high resolution TEM recordings could be made in real time, in situ and that the atomic behavior associated with materials reactions at interfaces could be deduced [3]-[5]. Moreover, with the advent of thin film and nanotechnology, the investigation of thin and nano-scale materials became a necessity [6]. In recent years, there has been an additional proliferation, most notably from in situ TEM in controlled environments such as in gases and liquids [1], [7]. This seminar gives a review of the application of in situ high resolution TEM to investigate material reactions, particularly those associated with interfaces important in electronic applications. An overarching theme of our work has been to ensure that the in situ studies are truly representative of the real behavior of the material system, and we have advanced a number of guidelines to ensure this. Moreover, we have also expanded our approach to environmental material-gas reactions such as carbon nanotube oxidation [8], hydrogen reactions with molybdenum sulphide catalysts, etc. [9]. The influence of the imaging electron beam is more important for the gaseous reactions, as it ionizes the reacting gas species, and it is necessary to develop protocols to take this into account. The procedures we have adopted to do this will be carefully described.

References:

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About the Speaker

Professor Robert (Bob) Sinclair has been a faculty member in the Department of Materials Science & Engineering since 1977. He obtained his degrees in materials science at Cambridge University, and was a postdoctoral scholar at the University of California, Berkeley for four years. His research has focused on the development and application of advanced transmission electron microscopy techniques, especially in situ high resolution microscopy, to basic materials studies related to semiconductor devices, magnetic recording, nanotechnology in cancer research and energy systems. At Stanford, he has been Department Chair (2004-2014), Director of the Stanford Nanocharacterzation Laboratory (2002-2013), Director of the Big Overseas Studies Program (2010-2012) and Associate Director of the Wallenberg Research Link (2013-present). He was Chair of the National Academy of Sciences Committee on "Midsize Facilities: the Infrastructure for Materials Research" (2003-2006), and he received the Distinguished Scientist Award (Physical Sciences) from the Microscopy Society of America (2009), The David M. Turnbull Lectureship of the Materials Research Society (2012) and the John M. Cowley Distinguished Lectureship, Arizona State University (2015).

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