Keynote Lecture

KN21

Local atomic structure determination using focused electron beams

J. Etheridge[1]

[1]*Monash University, Monash Centre for Electron Microscopy and Dept of Materials Engineering, VIC, Australia*

This talk will give an overview of methods for solving the atomic structure of nanostructured materials using focused electron beams. It will illustrate these methods with a range of applications, such as the determination of the atomic structure and stability of nanoparticle facets [1]; the local atomic structure of "chessboard' nanostructures in lithium-based titanate perovskites; and the measurement of local polarity, dopant concentration and atomic-scale morphology in semiconducting nanowire quantum wells. These methods take advantage of the fact that electron wavefields can be brought to a focal point smaller than an Ångström in diameter, enabling small volumes of matter to be probed and characterized. The wealth of information contained in the resulting diffraction patterns can be interrogated selectively to isolate and 'image' specific structural information. Several methods using small focused electron beams will be described in this talk, including; (i) An approach for the determination of centrosymmetric structures from the direct observation of structure factor phases by inspection of features in convergent beam electron diffraction patterns [2]. The method can achieve high resolution from just a few phase observations and no intensity measurements or iterative refinements are required; (ii) Methods for the quantitative interpretation of the intensity in atomic resolution imaging and diffraction data for the measurement of local atomic and electronic structure; (iii) Pseudo-confocal scanning transmission electron microscopy methods for obtaining depth and chemical information which record the scattered intensity in a plane conjugate to the specimen (as opposed to the diffraction plane) [3].

[1] *H. Katz-Boon, C. Rossouw, M. Weyland, A. M. Funston, P. Mulvaney, J. Etheridge, Nano Letts (2011) 11, 273–278,* ***[2]*** *P.N.H. Nakashima, A.F. Moodie, J. Etheridge, Proc Nat Acad Sci (2013) 110 14144-14149 (2013),* ***[3]*** *J. Etheridge, S. Lazar, C. Dwyer, G. A. Botton, Phys Rev Letts (2011) 106, 160802*

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