Keynote Lectures

[KN7] Solving the Structure of Nanostructured Materials using Focused Electron Beams.

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Electron beams can be focused to a cross-over smaller than an Ångström in diameter, providing a powerful tool for the characterization of local atomic and electronic structures. This talk will give an overview of methods for the determination of nanostructures using focused electron beams and will illustrate these with a range of applications, such as the measurement of nanoparticle facets at atomic scale [1]; the local polarity versus atomic-scale morphology of semiconducting nanowires [2]; the atomic structure of alloy precipitates; the long-range diamond and "chessboard" nanostructures in lithium-based titanate perovskites [3]; and the bonding charge distribution in aluminium [4]. Several methods using focused electron beams will be outlined in the talk, including:
(i) A new approach for the determination of centrosymmetric structures from the direct experimental observation of structure factor phases [5,6,7]. Phase is determined by inspection of features in convergent beam electron diffraction patterns, without the need to record intensity or execute a calculation. The method is illustrated with the determination of atomic positions in α-Al_2O_3 (with 30 atoms in its unit cell) to a resolution better than 0.1Å from the experimental observation of just 9 phases. (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) Scanning transmission electron microscopy methods which record the scattered intensity in a plane conjugate to the specimen (as opposed to the diffraction plane) for obtaining depth and chemical information [8].

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