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THE SUPERSTEM: AN ABERRATION CORRECTED ANALYTICAL MICROSCOPY FACILITY

A. Bleloch (1), R. Brydson (1,2), A. Craven (1,3), L.M. Brown, P. Goodhew, G. Tatlock (1, 4), M Gass (1) and M Shannon (1)

(1) SuperSTEM, Daresbury Laboratories, Warrington, Cheshire WA4 4AD, UK, (http:www.superstem.com), (2)University of Leeds, UK, (3) University of Glasgow, UK, (4) University of Liverpool, UK

Following the initial demonstration of aberration correction in scanning transmission electron microscopy (STEM) by Krivanek and the 'synchrotron in a microscope' paper by Brown, the United Kingdom electron microscopy community organized and supported a bid to set up a national facility (SuperSTEM) to exploit the technology of aberration correction for the benefit of the national and international community. Ultimately this facility was funded by the UK Engineering and Physical Sciences Research Council (EPSRC). The SuperSTEM laboratory building has been specified and designed so as to minimize instabilities caused by electrical interference, vibration (and sound), and thermal variations. Currently this building houses one instrument (SuperSTEM1): an old 100 kV VG STEM HB501 which has had an aberration corrector built by Nion Inc retrofitted. this machine currently achieves a probe size of 0.091 nm and an EELS energy resolution of of 0.4 eV. In 2006, a completely new NION instrument (SuperSTEM2) will be commissioned which aims to achieve a probe size of 0.08 nm, this will also possess a much more flexible stage with cooling facilities as well as an EDX detector. We will highlight the performance of the first instrument using examples from a wide range of materials including minerals, nanoparticles and biogenic materials.

Hitherto, a great deal of our understanding of the optics of the electron microscope has been dominated by the spherical aberration of the objective lens, for example choosing the optimal aperture and interpreting images in terms of the contrast transfer function.

The advent of practicable spherical aberration correction in two laboratories in the last decadehas changed the way in which we approach many of these tasks. The relative merits and areas of application of conventional transmission electron microscopy (CTEM) and scanning transmission electron microscopy (STEM) are a part of this new debate. Building an aberration corrector into a STEM makes particular use of the strengths of that instrument; namely, an optimal configuration for high angle annular dark field imaging (HAADF) coupled with electron energy loss spectroscopy (EELS) giving the facility to perform electron energy loss at the highest spatial resolution..

An integral part of the SuperSTEM facility is the provision of remote access to the instruments. We have performed some demonstration experiments from which we have learned that the instrument will be operated most effectively as a three-way conference between the remote user, the local operator and the instrument, rather than having autonomous remote operation of all parameters of the instrument.

References:

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