Electron Diffractive Imaging of a Single Nanoparticle

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The coherent electron diffractive imaging offers a promising path toward characterization of the individual nanostructures at the near atomic resolution [1]. In this microscopy, the complex exit surface wavefunction can be recovered from the far-field diffraction pattern using iterative algorithms.

In this present work, the diffraction intensities of the individual MgO nanoparticle with a size of about 24nm were recorded along [001] on the imaging plate (see Fig. 1a). The FEG-transmission electron microscope (JEOL 2010F) was operated at 200-keV accelerating voltage in the nanoarea electron diffraction regime. Due to short exposure time, the scattering from the carbon substrate [2] is localized within the central beam and can be removed directly from the measured pattern. Enlarged image of the one Bragg peak (see Fig. 1b) shows the intensity modulations along the four fringes oriented perpendicularly to the faces of cubic-shaped nanoparticle. The detailed experimental procedure will be discussed in the workshop.

For the phase recovery we utilize the charge-flipping algorithm which does not require a priory knowledge of the support [3]. Figure 2 shows the phase (2b) and modulus (2c) of the reconstructed wavefunction. This result is in agreement with the high-resolution image of the particle. In the workshop, we will also present preliminary study for the 3D particle shape recovery from the oversampled intensity in the region of the one reciprocal lattice point.

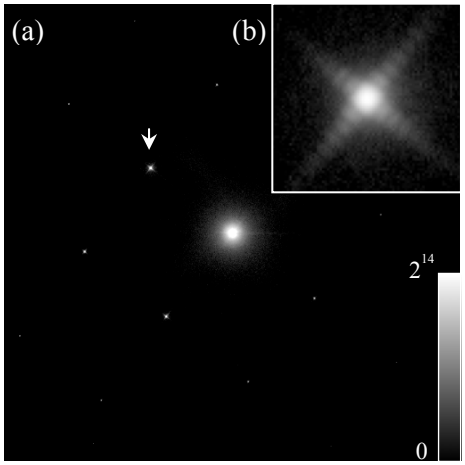

Figure 1: (a) Measured diffraction pattern from MgO nanoparticle near the zone axis of [001]. (b) Enlarged image of the Bragg peak labeled by the arrow.

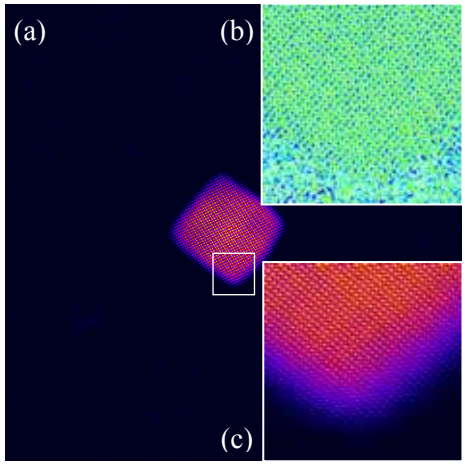

Figure 2: (a) Reconstructed modulus of the exit wavefunction. (b) Enlarged image of the phase and (c) modulus of the wavefunction from the selected region.

References:

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