

NANOCRYSTAL PHASE IDENTIFICATION BY LATTICE FRINGE FINGERPRINTING IN TRANSMISSION ELECTRON MICROSCOPES

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On the basis of our kinematical theory (P. Fraundorf et al., *J. Appl. Phys.* **98** (2005) 114308) of lattice fringe visibility in phase-contrast high-resolution transmission electron microscopy (TEM) images, we developed a method to identify the crystal phase of nanocrystals. Nanocrystal phase identification proceeds by the comparison of theoretical fringe fingerprint plots to experimental fringe fingerprint plots (P. Moeck et al., *Proc. of SPIE* **6000** (2005) 60000M-1). For example, Figs. 1a and 1b represent theoretical plots of angles of lattice fringe crossings versus spatial frequencies for the TiO₂ phase rutile. Because kinematically forbidden data points may be present in experimental fringe fingerprint plots due to double diffraction, one need for search and match procedures fringe fingerprint plots in the kinematical limit, Fig. 1a, and the double-diffraction limit, Fig. 1b. Such plots are very characteristic “fingerprints” of the respective nanocrystals as they appear in high-resolution TEM images.

Since all interfringe angles are identical for equally indexed fringes of cubic crystals, the presence or absence of glide planes and screw axes manifests itself in (kinematical limit) fringe fingerprint plots of cubic crystals by the absence or presence of kinematically forbidden data points. Although already feasible in the current generation of high-resolution TEMs, lattice fringe fingerprinting will become much more viable in their objective lens aberration-corrected counterparts.

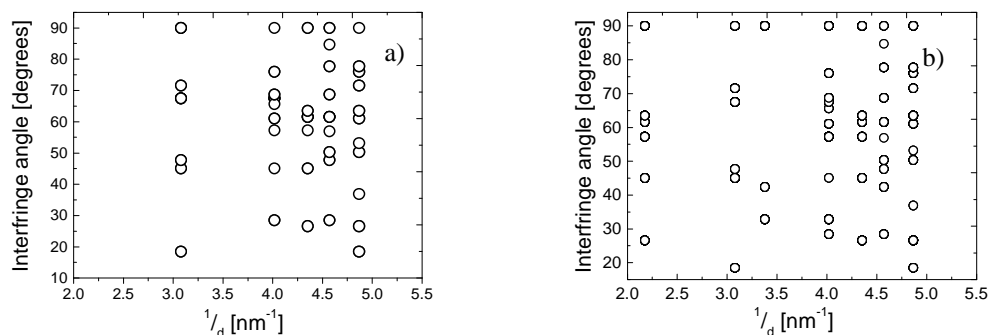


Fig. 1: Theoretical fringe fingerprint plots for the TiO₂ phase rutile, space group P 4₂/mnm, at 0.19 nm point-to-point resolution (Scherzer in case of phase contrast) of a TEM or scanning TEM; (a) kinematical limit and (b) double-diffraction limit.