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QUANTITATIVE HRTEM INVESTIGATION OF AN OBTUSE DISLOCATION REACTION IN GOLD WITH A Cs CORRECTED FIELD EMISSION MICROSCOPE

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Nowadays material science benefits from high-resolution transmission electron microscopy (HRTEM) with a resolution that extents to the information limit of field emission microscopes that can reach into the sub Angstrom region. The procedure involves a reconstruction of the electron exit wave from a focal series of images or imaging with a Cs corrected microscope. We utilized a CM200 FEG instrument equipped with a Cs corrector [1] to investigate quantitatively the core structure of an obtuse dislocation reaction in gold. A determination of the structure from a single lattice image is compared with the result from an exit wave reconstruction. Quantitative information is obtained by extraction of the column positions surrounding the dislocation core with precision on a pm level. Moreover, it is shown that the large scattering power of the gold atoms (atomic number z = 79) can be utilized to extract the number of gold atoms in individual atomic columns from reconstructed electron exit-waves of wedge shaped samples. A comparison of multi-slice calculations with experiments gives guidelines on how resolution affects the limit as to which the number of atoms in a particular column can be determined from a phase change of the electron exit wave. Since the magnitude of the phase change oscillates with sample thickness and depends on resolution, it is principally possible to probe the information limit of an electron microscope through the maximum phase change that occurs on a wedge shaped sample.

[1] M. Haider, H. Rose, S. Uhlemann, E. Schwan, B. Kabius, K. Urban, Ultramicroscopy 75 (1998) 53

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