A quantitative method for measuring small residual beam tilts in high-resolution transmission electron microscopy

Ming, W.[1], Chen, J.[1], Allen, C.S.[2], Duan, S.[1] and Shen, R.[1]

[1] Hunan University, China, [2] University of Oxford, United Kingdom

In a transmission electron microscope, electron illumination beam tilt, or the degree of deviation of electron beam from its optical axis, is an important parameter that has a significant impact on image contrast and image interpretation. Although a large beam tilt can easily be noticed and corrected by the standard alignment procedure, a small residual beam tilt is difficult to measure and, therefore, difficult to account for quantitatively. Here we report a quantitative method for measuring small residual beam tilts, including its theoretical schemes, numerical simulation testing and experimental verification. Being independent of specimen thickness and taking specimen drifts into account in measurement, the proposed method is supplementary to the existing "rotation center" and "coma-free" alignment procedures. It is shown that this method can achieve a rather good accuracy of 94% in measuring small residual beam tilts of about 0.1° or less.

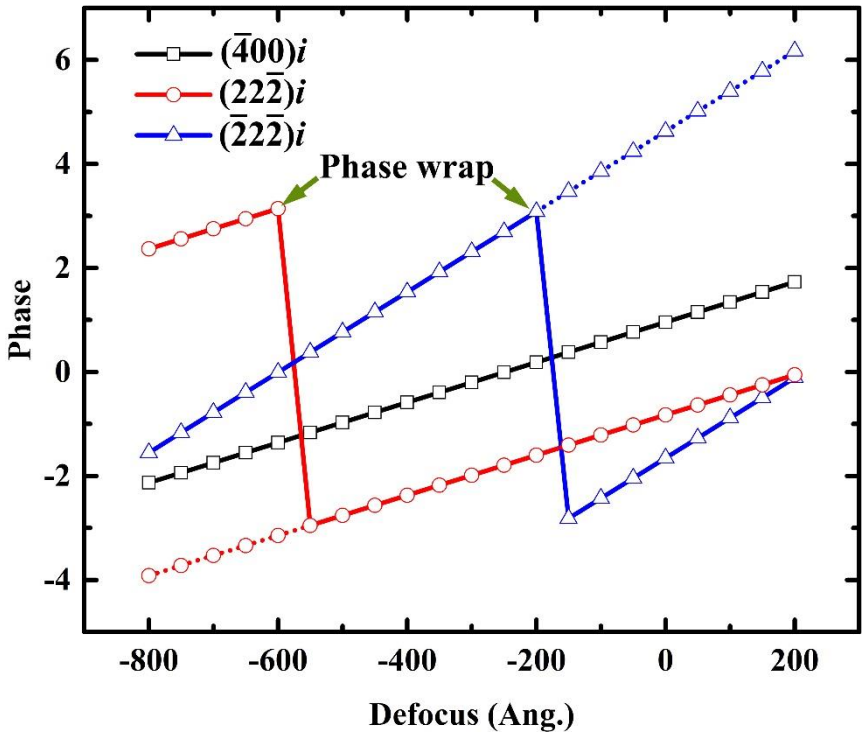

Fig. 1. Phase changes of the diffractogram spots, i, i and i, as a function of defocus. The defocus step between two successive defocus values is 50 Å. The jump points marked by arrows are due to the wrapping effect of the phase term.