Symmetry of Dislocation Images in Transmission Electron Microscopy

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The application of the reciprocity theorem in the field of electron diffraction has led to a number of useful relations between intensities of various diffracted electron beams [Pogany, A. P. & Turner, P. S. (1968). Acta Cryst. A24, 103]. Apart from perfect crystals, the theorem can also be applied to images of individual lattice defects, e.g. planar faults and dislocations [Howie, A. (1972). Proc. Fifth European Congress Electron Microscopy, Manchester, p. 408; Schapink, F. W. (1973) Phys. Stat. Sol. (b), 56, K61]. The symmetry relations for dislocation images, both in bright field and dark field, are investigated in some detail. They may be divided into two groups: (i) Symmetry due to application of the reciprocity theorem, followed by a symmetry operation of the crystal associated with the diffraction vector (mirror inversion or central inversion). The relations found do not depend on the specific properties of the dislocation displacement field. (ii) Special relations due to symmetry properties of the displacement field, for particular dislocation geometries. The resulting symmetry depends on the degree of elastic anisotropy of the crystal.

On Some Integral Aspects of the Dynamical Theory of Electron Diffraction

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\[ \tilde{\varphi}(\xi) \cong [\tilde{\varphi}(x,0) \otimes \delta(x) + i \pi t_0] \left[ \pm \exp \left( \frac{2i\pi k_0 \xi}{\xi_0} \right) \right] \]  

where

\[ \tilde{\varphi}(x,0) = \frac{\varphi(x,0)}{4i\pi} - \frac{1}{k_0^2} \varphi(x,0), \quad t_0 = \alpha \sum_k v_{g-k} \varphi_k \]  

and neglecting the term of backward diffusion as well as \( w^*_g \), one obtains the integral expressions relative to the column approximation (zeroth order approximation)

\[ \varphi_g = \left[ \varphi_0 \otimes \delta_0 + i \frac{\pi}{k_0} t_0 \right] \cdot Q_g \]  

where \( Q_g = \varphi(z) \exp \left( 2i\pi t_0 \xi \right) \).

or alternatively

\[ \varphi_g(r,z) = [\exp \left( 2i\pi t_0 \xi \right) \xi] \left[ \varphi(z) \varphi_0 + i \frac{\pi}{k_0} \cdot \int_0^1 t_0(r,\xi) \exp \left( -2i\pi t_0 \xi \right) d\xi \right] \]