where τ_g^+ is the excitation error $(\varepsilon_g^2/2k_g)$. In the derivation of (4) or (5), φ_g' has been neglected against $k_g\varphi_g$. The differential formalism may be obtained by deriving the convolution product (4) with respect to z. In this way, the differential formalism of Howie and Whelan can be regarded as the convolution inverse of the corresponding integral formalism. Effectively, writing $Q_g^{(-1)*}$ for the convolution inverse of Q_g,

$$Q_g^{(-1)*}=\delta_0'(z)-2i\pi\tau_g^+\delta_0(z)\,, \tag{6}$$

one obtains from (4)

$$\varphi_g'=\varphi_g^0\otimes\delta_0+i\,\frac{\pi}{k_g}\,[t_g-2k_g\tau_g^+\varphi_g]\,. \tag{7}$$

The standard form of Howie and Whelan [Whelan, M. J. (1970). *Modern Diffraction and Imaging Techniques in Material Science*, 35. Amsterdam: North-Holland; Lannes (1973)] can be obtained from (7) by proceeding to the change of variables

$$a_g=[\exp\,(2i\pi\mu_g)]\varphi_g \quad \text{where} \quad \mu_g=\mathbf{g}\,.\,\mathbf{W}\,. \tag{8}$$

With the kinematical approximation [Gevers, R. (1970). *Modern Diffraction and Imaging Techniques in Material Science*. I. Amsterdam: North-Holland] one gets the corresponding expressions of φ_g from (4) or (5) by performing the perturbation approach

$$t_g\simeq y\propto v_g\varphi_0\simeq y\propto v_g\varphi_0^0\,. \tag{9}$$

Effectively, taking into account (5), (9) and the change of variables (8), a_g can be written according to the kinematical expressions

$$a_g=[\exp\,2i\pi(\tau_g^+z+\mu_g)]\,[y(z)\varphi_g^0+i\,\frac{\pi}{\zeta_g}\exp\,(i\theta_g\varphi_0^0\int_0^z\exp[-2i\pi(\tau_g^+\zeta+\mu_g)]\mathrm{d}\zeta]\,. \tag{10}$$

As can easily be shown from (4), (7) or (10), the distribution theory allows a convenient description of the boundary conditions.

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Calculated Images of Crystal Lattices by Axial Illumination with 1 MeV Electrons

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N-beam (001) electron-microscope lattice images (N=3,5,9) are calculated for gold when 1 MeV electrons and axial illumination are used. Conditions for obtaining images showing no artificial periodicity are determined. It is shown that in a particular range of thickness (40–60 Å or 140–160 Å) and with the proper defocusing distance high-contrast images would be obtained: the exact projected atomic positions are directly visible on these images. The influence of departure from exact symmetry conditions, and of large variation of the lattice parameter, are also studied. These calculations suggest that it would be possible to observe direct lattice images of metals and to study their defects with actual 1 MeV electron microscopes.