Chapter 17
Appendix H: From the Electron Energy Loss Spectrum to the Dielectric Function

The ELF in the optical limit can be obtained by means of a transformation of the experimental transmitted electron energy loss spectrum (EELS). Such a transformation can be applied to the EELS after erasing the elastic peak and multiple scattering in order to deal with the single-scattering spectrum $S(W)$.

17.1 From the Single-Scattering Spectrum to the Energy Loss Function

The relationship between the single-scattering spectrum $S(W)$ and the ELF, $\text{Im}\left[\frac{-1}{\varepsilon(q=0,W)}\right]$, is given by [1–3]

$$S(W) = \frac{I_0 t}{\pi a_0 m v^2} \text{Im}\left[\frac{-1}{\varepsilon(q=0,W)}\right] \ln\left[1 + \left(\frac{\beta}{\theta_W}\right)^2\right] \quad (17.1)$$

where I_0 is the zero-loss density, t is the sample thickness, a_0 is the Bohr radius, m is the electron mass, v is the incident electron velocity, β is the collection semi-angle, $\theta_W = \frac{W^2}{\gamma m v^2}$ is a characteristic scattering angle for energy loss W, and γ is the relativistic factor.

After collecting the transmitted electron energy loss spectrum and applying to it the so called Fourier-Log transformation –for erasing the elastic peak and multiple scattering [1]–, the transformation described by Eq. (17.1) allows to obtain the ELF.

M. Dapor, *Transport of Energetic Electrons in Solids*,
Springer Tracts in Modern Physics 257, DOI 10.1007/978-3-319-47492-2_17

17.2 Summary

We described a method for calculating the ELF in the optical limit using the experimental transmitted electron energy loss spectrum.

References

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3. D.T.L. Alexander, P.A. Crozier, J.R. Anderson, Science **321**, 833 (2008)