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Perforated Carbon Film AGS100

This is an exceptionally useful specimen for testing the performance of an electron microscope. The possibilities of its use were originally outlined by Haine and Mulvey (1954).

The preparation is usually used for correcting astigmatism, by adjusting the width of the over-focused Fresnel fringe to be uniform around a small hole in the film.

When the correction has been made, any small residual astigmatism can be calculated by measuring the width of the over-focused fringe at its maximum and minimum widths. Then, resolution as limited by astigmatism is:

$$d_a = \frac{\sqrt{d^2_{max} - d^2_{min}}}{\sqrt{1.4}}$$

As an example of d_{max}= 1nm d_{min} = 0.8nm

$$d_a = \frac{\sqrt{1 - 0.64}}{\sqrt{1.4}} = 0.51\text{nm}$$

If a focus is adjusted until a fringe is clearly visible all around the circumference of a hole, it is safe to say that the instrumental limitations will not limit the resolution to a worse figure than the maximum fringe width measurable anywhere round the hole.

The paper by Haine and Mulvey gives guidance on the detection of other defects with the aid of observations on the fringe.

Reference

M.E. Haine and T. Mulvey (1954). The regular attainment of very high resolution in the electron microscope.
Proc. 3rd Int. Cong. for Elec. Mic. London p. 698.

The perforated carbon films contain a large number of holes of varying size (ranging from several micrometers down to say 50nm in diameter). For the purposes of the resolution check, we only consider the smallest holes; the criterion is that these should be small enough to be contained within the field of view of the viewing telescope at electron optical magnifications up to say 250,000x. These holes should also be approximately round if they are to be of value in the test. Other holes may not be round, but no test is applied to cover size or shape distortion.