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DIFFRACTION STANDARDS

General Instructions

Diffraction pattern ring diameters can be simply related to the lattice plane spacings in the crystal used as the specimen.

For a lattice spacing d, in a microscope of effective camera length L and operating at an accelerating voltage corresponding to a wavelength λ, the diffraction ring diameter is r where

$$\lambda L = dr$$

It is not easy to measure the actual value of L or know the precise value of accelerating voltage. However, without knowing the exact values of λ and L, one can determine an unknown lattice spacing by measurement of r, if the instrument has first been calibrated with a known substance.

This can best be done by using a polycrystalline material of known lattice spacings, so that continuous diffraction rings are available for measurement. The ring diameters must all be measured in the same plane relative to the microscope (to avoid any errors due to ellipticity of the pattern).

Furthermore, the calibrating ring diameter chosen should be similar to that required to be calibrated since there may be distortion of the relative ring diameters due to residual barrel or pincushion distortion in the projector lens system.

S110/S111 Evaporated Thallous Chloride

Thallous chloride has a simple cubic structure with a = 0.3842 nm.

If $N = h^2 + k^2 + l^2$, the principal lattice spacings are as follows:

N	Lattice Spacings (nm)
1	0.384
2	0.272
3	0.222
4	0.192
5	0.172
6	0.157
8	0.136
9	0.128
10	0.121

The thallous chloride is evaporated on to a carbon substrate to form a polycrystalline layer.

S108/S109 Evaporated Aluminium

Aluminium has a face centred cubic structure, with a = 0.4041 nm.

If $N = h^2 + k^2 + l^2$, the principal lattice spacings are as follows:

N	Lattice Spacings (nm)
3	0.234
4	0.202
8	0.143
11	0.122
12	0.117
16	0.101

S112/S113 Molybdenum Oxide Crystals

This test specimen is most useful to determine the rotation between a diffraction pattern and the selected area image. Select a thin crystal not overlaid by others, so that a clear Laue diffraction pattern is obtained.

Starting from the diffraction pattern, change the strength of the diffraction lens until each diffraction spot shows a small image of the crystal. It will be possible to determine the sense of the rotation of the image as the magnification is increased. Check whether there is an image inversion between the diffraction position and the selected area magnification.

The actual magnitude of the rotation angle between the crystal and its pattern can be determined by recording both image and diffraction pattern on a single plate. The correct rotation angle between pattern and image can then be determined by taking into account the sense of rotation and any image inversion.

High Dispersion (Low Angle) Diffraction

S124/S125 Calibration by Catalase Crystals

The main lattice spacings of catalase crystals (8.75nm and 6.85nm) may be used to calibrate the camera length of a transmission microscope operating in high dispersion diffraction; that is, with the objective switched off and with illumination focused by condenser 2 on to the object plane of the intermediate lens.