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LATTICE PLANE RESOLUTION TESTS

The resolution of crystal lattice planes is a useful test of the performance of an electron microscope, particularly mechanical and electrical stability. The crystal spacings are known accurately from X-ray data, and therefore the high magnification used can be calibrated with accuracy.

The crystal specimens are mounted on perforated carbon films, and wherever possible, thin crystals which cross one of the holes should be selected, so that interfering structure from the support film is not encountered.

Good crystals can usually be located by checking the selected area diffraction pattern - unless a clear single crystal pattern is obtained the lattice planes will not be observed. When a suitable crystal has been selected, a very high electron optical magnification should be used, so that the lattice planes can clearly be resolved on the fluorescent screen under the viewing telescope. The objective lens focus has to be adjusted carefully to optimise the contrast. The phase contrast of a given crystal lattice spacing is critically dependent on the amount of objective lens defocusing.

If the contrast is inadequate a significant improvement may be obtained by defocusing the condenser lens (reduction of illumination semi-angle).

Further improvement may be brought about by tilting the illuminating beam so that the central beam and first order diffraction spot are symmetrical about the instrument axis (take care that the objective aperture is large enough to accept the diffracted beams).

AGS136 Copper Phthalocyanin Lattice plane spacing 1.03nm

This compound has a useful wide crystal spacing. However, it is rather susceptible to radiation damage, and it is therefore advisable to take great care not to study a crystal too long before attempting to photograph it.

The electron optical magnification should not be over 100,000x, or the beam intensity required will be too high.

The lattice plane spacings lie parallel with the long axis of the crystals.

AGS135 Orientated Gold Crystals

The evaporated gold is induced to grow in a (100) orientation. This gives lattice plane spacings of 0.204mm for the (200) planes and 0.143mm for the (220) planes. If the crystal thickness happens to be suitable, and if the objective aperture is large enough to accept the required diffracted beams, a spacing of 0.102mm can be imaged with a suitable focal setting. This specimen thus provides a valuable test for the best microscopes in service.

AGS122 Asbestos (Crocidolite) Lattice spacings 0.903 and 0.452nm

These crystals occur as long needles and display good diffraction patterns. The planes parallel with the long axis of the crystals are of the 0.903nm spacing; the planes of spacing 0.452nm lie at about 60 degrees to this.

Some of the crystals in the preparation show a globular structure under electron irradiation, but a good proportion of the crystals appear unaffected by the beam, and yield clear lattice pictures.

AGS118 Potassium Chloroplatinate Lattice spacing 0.563nm

In order to obtain thin enough crystals of this compound, the preparation of Komoda and Sakata (1959) is used. This involves mixing the preparation with gelatine and spraying it on to a hot surface, so that the droplets dry very quickly, and the crystal is obliged to grow beneath the gelatine layer in a platelike form.

The spray droplets can readily be identified on the preparation - choose one with thin crystals along the edge of the drop. When the specimen is irradiated with a high intensity beam, the gelatine crystals are stable. They do not appear to have well-defined faces, but can be located by electron diffraction.

It is advisable to tilt the specimen at 35° to the horizontal to reveal the 0.563 plane spacings of the K_2PtCl_6

Reference:

T. Komoda and S. Sakata (1959). Direct observation of K_2PtCl_4 and K_2PtCl_6 crystal lattices and the specimen technique.
J. Electron Microscopy 7 pp 27-31.

AGS140 Graphitised Carbon Black Lattice spacing 0.34nm

These graphitised carbon black particles have lattice planes following the contours of the particles. For a good test of the instrument, choose a field of view where the lattice planes run in several different directions.