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R.G. BLAKE
P.M. KELLY
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ABSTRACT

The inclined specimen cartridge is designed to hold 3 mm discs at a predetermined angle to the beam. The cartridge fits a standard double tilt goniometer stage, no modifications of the microscope are required and the full tilt range of the goniometer stage is still available. Loading and operational instructions are outlined with the aid of a sectional diagram.

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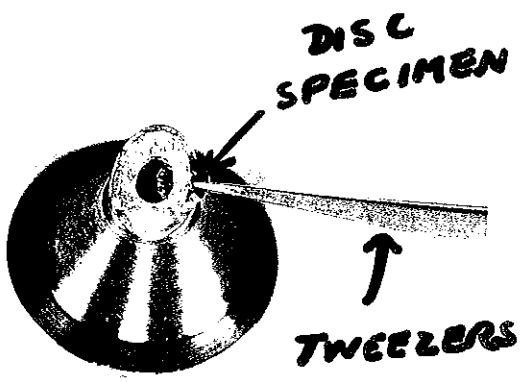
CONFIGURATION; CONTAINERS; CRYSTAL LATTICES; GONIOMETERS; MECHANICAL STRUCTURES; OPERATION

With uniaxial metals having a high degree of texture the usual range of tilt angles available in electron microscope goniometer stages (± 30°) is often insufficient. An example of this occurs in zirconium alloy sheet where the normal rolling texture results in the c-axis lying at right angles to the rolling direction and inclined at thirty to forty degrees to the sheet normal. There are two such c-axis orientations related by a 180° rotation about the sheet normal and each orientation occurs in approximately half of the grains of the polycrystalline sheet. Under normal conditions a thin foil specimen made from such a sheet will tend to be oriented so that the electron beam bisects the 60 to 80° angle between these two equivalent c-axis positions. Consequently a tilt of 30° in the electron microscope goniometer stage will not be sufficient to ensure obtaining a c-axis orientation and the nearest prism orientation $[11\bar{2}0]$ requires 50 to 60° of tilt. Both the [0001] and the $[11\bar{2}0]$ orientations are extremely useful in contrast studies of defects such as dislocations and loops. These two orientations can be achieved by mounting the specimen at an angle of about 40° in an inclined specimen cartridge, which still allows the specimen to be tilted in the goniometer stage. Provided the thin foil specimen is suitably oriented in the inclined cartridge, the electron beam will be within 10° of the c-axis orientation for half of the grains in the zirconium sheet specimen and within 10 to 20° of the prism orientation for the other half. Both the c-axis and the prism orientations are thus well within the ± 30° tilt range of the goniometer stage. If the foil specimen is removed from the cartridge, rotated by 180° and replaced, the grains that were previously close to c-axis orientation become close to prism orientation and vice versa. This allows contrast experiments on a particular area to be carried out in both these orientations even though they are 90° apart.

An inclined cartridge designed to fit into the JEM-7A double tilt goniometer stage is shown in Figure 1. The cartridge was made specifically to hold 3 mm disc specimens, which are relatively robust. It could be modified to take 2.4 mm discs or even thin foils sandwiched between grids and the angle of inclination can be chosen to suit the particular application. The cartridge is loaded in the normal way, no modifications to the microscope are required, the operation of the anti-contamination device is not affected, and the full tilt range of the goniometer stage is still available. The disc specimen (3) is loaded into the cartridge by sliding it into the slot between the base of the cartridge body (1) and the copper shim (2). The thickness of this slot is designed to provide just enough friction to hold the specimen in place. The specimen is removed by pushing it out of the slot with a metal strip thinner than the disc and 2.5 mm wide.

The cartridge has been extremely easy to load and use. To obtain the required results with zirconium sheet specimens, the rolling direction of the specimen must be approximately parallel to the machined slot in the holder. The rolling direction in the sheet can be indicated on the disc specimen by producing a small flat on the side of the disc parallel to the rolling direction. This can be done when the disc is first cut from the sheet or by gently abrading the appropriate edge of the disc with emery paper prior to thinning. Even if the rolling direction is not known the appropriate position in the specimen cartridge is readily found by trial and error, mounting the disc in the cartridge and subsequently rotating it if the original position is not the one required. The only limitations encountered with the inclined cartridge were obstruction of the field of view at large tilts, when the area under examination was more that 0.75 mm from the centre of the disc, and the increase in effective foil thickness when the specimen had been tilted so that its normal was about 70° to the electron beam.



METHOD OF LOADING SPECIMEN.

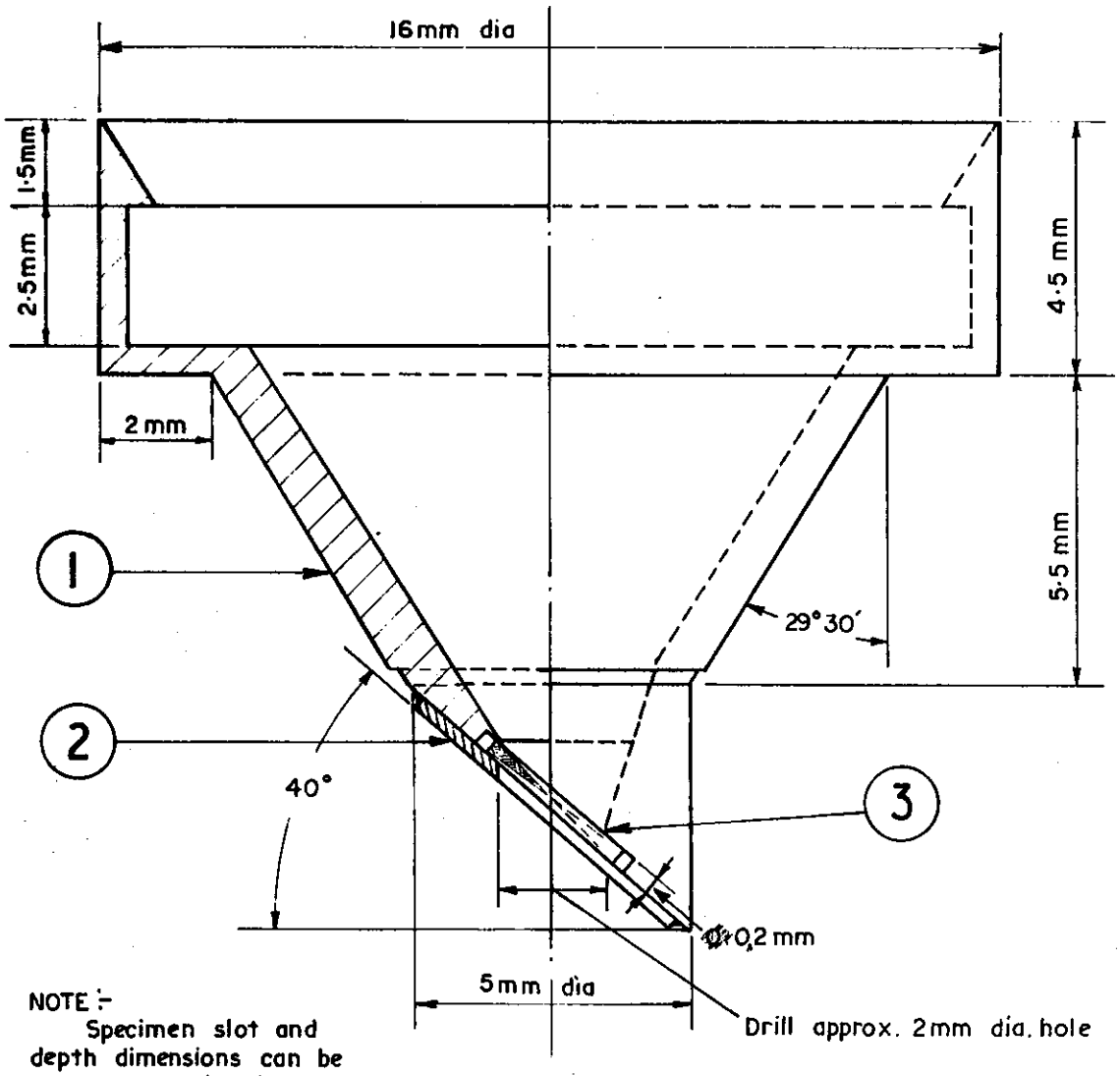


FIGURE 1. SECTIONAL DIAGRAM OF THE INCLINED SPECIMEN CARTRIDGE