Letters

The Generation of Dislocations in Bicrystals of Sodium Chloride by Hydrostatic Pressure

It is now generally recognised that the application of a hydrostatic pressure of the order of 10 kbars can result in the generation of dislocations in polycrystals of cubic metals, e.g. ironcarbon alloys [1] and chromium [2]. As solids possessing the cubic structure have isotropic linear compressibilities, the presence of grainboundaries, to the first approximation, should not result in local shear stresses [3]. Bullen and Wain [2] and Das and Radcliffe [4] have accordingly suggested that elastic discontinuities, e.g. particles or voids, are responsible for the generation of dislocations under hydrostatic pressure. The mechanical properties of Si-Fe are affected by pressurisation similarly as those of steel and chromium; Worthington [5], however, did not observe nucleation of dislocations at precipitate particles, but suggested that the pressurisation treatment resulted in an increase in activity of grain-boundary sources (during subsequent straining). In another study of pressurised chromium Mellor and Wronski [6] report that arrays of dislocations were seen which appeared to have been generated by precipitate particles and by grain-boundaries. For the hexagonal metals, e.g. cadmium and zinc possessing high degrees of anisotropy in the linear compressibility [3], no deformation has been observed in monocrystalline specimens pressurised at 26 kbars, but polycrystals exhibited grain-boundary migration, slip, multiple slip and twinning.

Similar considerations should apply to nonmetallic crystalline solids, which, however, appear not to have been investigated. We have initiated accordingly a programme of study of pressurisation effects in ionic solids, initially in the cubic sodium chloride. The purpose of this communication is to report the effect of a 10 kbar pressurisation on the dislocation substructure of mono- and bi-crystalline specimens.

The experiments were performed on specimens cleaved in {100} orientation from several single crystals and one bicrystal grown from Analar NaCl by the Czochralski method. The grainboundary misorientation was 8°. The specimen dimensions were approximately $10 \times 2 \times 2$ mm. The specimens were annealed at 650° C to remove internal stresses produced by cleavage and then cooled to room temperature over a period of 35 h. All specimens were then polished and etched and several areas of their surfaces photographed. The polishing solution was a mixture of 1 part methyl alcohol with 1 part ethyl alcohol and the etchant was 1 part methyl alcohol with 2 parts glacial acetic acid. The



Figure 1 (a) An area of a {100} face of a NaCl single crystal in a slowly-cooled condition after etching. Note the presence of sub-grain-boundaries. (b) The same area photographed after a 5 minute pressurisation at 10 kbars, polishing (to remove 15μ m off the surface) and etching. Note the precise correlation between the etch-pits and their position in comparison with (a).

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