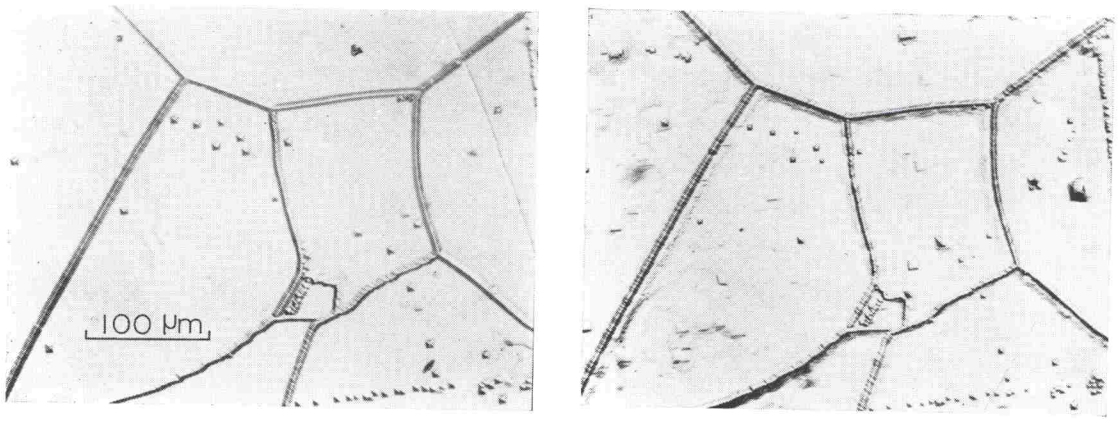
Letters

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. iron-carbon alloys [1] and chromium [2]. As solids possessing the cubic structure have isotropic linear compressibilities, the presence of grain-boundaries, *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 non-metallic 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 grain-boundary misorientation was 8°. The specimen dimensions were approximately 10 × 2 × 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



(a) (b)

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 15μm off the surface) and etching. Note the precise correlation between the etch-pits and their position in comparison with (a).