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DISLOCATION PILE-UPS IN ANTIMONY SINGLE CRYSTALS

It is well known that dislocations move under stress and when the motion of dislocations in a slip plane is obstructed by an obstacle which may or may not be in a slip plane, pile-up is observed. The final arrangement of these dislocations in a pile-up is such that the forces on them from the applied stress, the obstacle and their mutual interaction are in equilibrium.[1,2] Assuming such an equilibrium and that dislocations are parallel, the stress (σ_p) on the *i*-th dislocation in a pile-up is given by[1]

$$\sigma_p \propto \sum_{\substack{i=1 \\ i \neq j}}^{n} (x_i - x_j)^{-1} \qquad (1)$$

A plot of the summation against x_j should be a straight line of zero slope. Young[3,4] has made detailed study of the spacing of etch pits in pile-ups in copper single crystals and has shown that the spacings do not conform to the theoretical estimate. He has suggested that this may be due to the fact that the barrier may not be in the plane of observation and the negative result should not be considered as a failure of the theory. The dislocation spacing in pile-ups in the case of antimony single crystals has been presented here.

Single crystals of antimony were grown from melt in a horizontal furnace in an atmosphere of purified hydrogen in open graphite boats. The crystals were cleaved in the conventional way at the temperature of liquid air. The cleavage stress itself is found to cause plastic deformation in these crystals.

Etch method was adopted to reveal dislocations in the (111) planes of the crystals. Various reagents have been reported which reveal dislocations in antimony crystals. After numerous trials proper reagent was selected for revealing dislocations. A reagent consisting of 3 parts HF, 5 parts fuming HNO_3 and 3 parts glacial acetic acid was used to etch the crystals. The effectiveness of the reagents to reveal dislocations was established by (*a*) matching of the pits on the cleavage counter parts and (*b*) measuring the dislocation densities along the intersecting sub-boundaries.

Figure 1 shows a pile-up of dislocations in antimony crystal. The dislocation spacings were measured and the summation given in equation (1) is plotted in Fig. 2. The nature of the graph is similar to that obtained for copper by Young.[4] Deviation from expected spacing for a group of parallel dislocations under uniform external stress is observed in antimony crystals also.

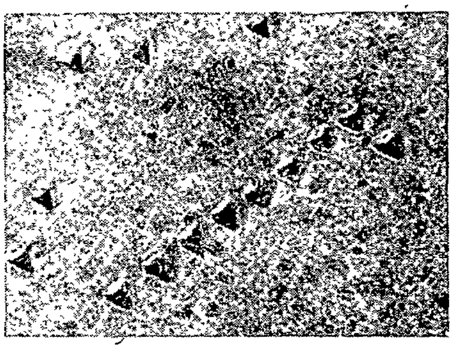

FIG. 1. × 575.

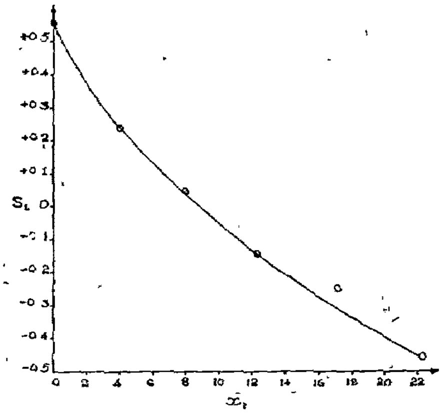

FIG. 2

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