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Berkeley, California

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DISLOCATION ETCH PITS IN HEXAGONAL Ag-Al INTERMETALLIC PHASE

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In recent years special etching techniques have been used to reveal dislocations in a number of crystals.[1-3] This note describes some of the observations on single crystals of hexagonal Ag-Al alloy containing 33 at. % Al. Single crystals were prepared from high purity material such that one of the edges of the crystal exposed the basal plane. The etching reagent consisted of 5 parts of concentrated H_2SO_4, 7 parts of 30% H_2O_2, and 5 parts of concentrated HF. The surfaces to be etched were mechanically polished with fine emery paper and then polished electrolytically. Care was taken to see that the surface did not deviate far from the (0001) plane. The crystals were etched for about a minute, rinsed thoroughly in water and then in ethyl alcohol and dried by a current of warm air.

Figure 1 shows the etch pits which were formed. The pits are hexagonal in shape and randomly distributed on the (0001) plane. The etching time is not critical, the number of pits remains relatively constant for a wide range of etching time and prolonged etching only makes the pits larger. The pyramidal shape of the pits is not changed except when the dislocation corresponding to a particular pit disappears, the pits grow laterally forming flat bottomed pits (A, B, C, in Fig. 1) as has been observed in LiF.[4] A pit count gives an average value of the order of $10^5/cm^2$.

Rows of closely spaced etch pits and branching rows of etch pits resembling low angle tilt boundaries were observed. It has been shown[5] that the number of edge dislocations n_A, n_B, n_C, in each of three intersecting tilt boundaries A, B, C, are approximately related by the expression

$$n_C = n_A + n_B \tag{1}$$

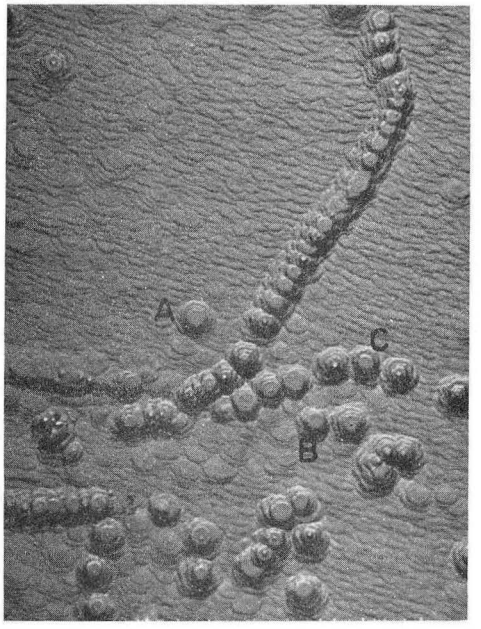

FIG. 1 ETCH PITS OF DISLOCATIONS IN Ag-33 AT. % Al. (X 500).

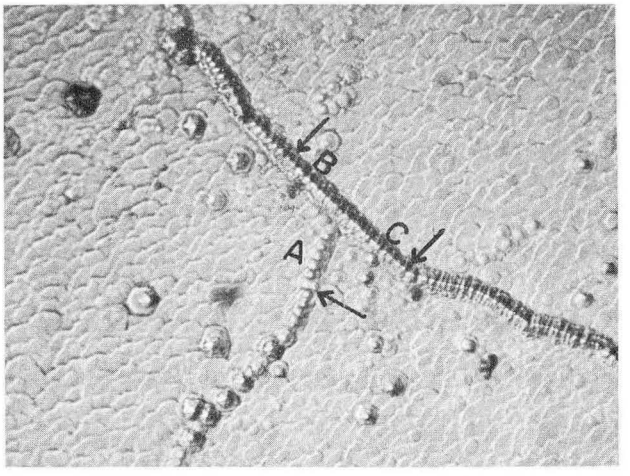

FIG. 2 ETCH PITS IN INTERSECTING BOUNDARIES. (X 500). (SEE TABLE I.)

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For a two branch boundary the expression becomes

$$n_C = n_A . \tag{2}$$

Table I gives the counts corresponding to Figs. 2-4. The excellent agreement of the etch pit counts with the dictates of Eqns. 1 and 2 indicates that the etch pits are sites of dislocations.

Table I

Etch pits per 100μ of intersecting boundaries

Figures	Boundary A	Boundary B	Boundary C
2	19	39	55
3	27	15	43
4	35	--	35

Further support of this thesis is supplied by the fact that the etch pits appear along slip traces. Figure 5 shows the regular array of etch pits along crystallographic directions on the surface of a crystal which has been indented using a ball indenter. Except for the twin bands (which show a type of fine structure formation after etching) no slip traces were visible even under high magnification. After polishing and reetching the pits reappeared. The etching of slip lines does not seem to depend on the presence of slip steps.

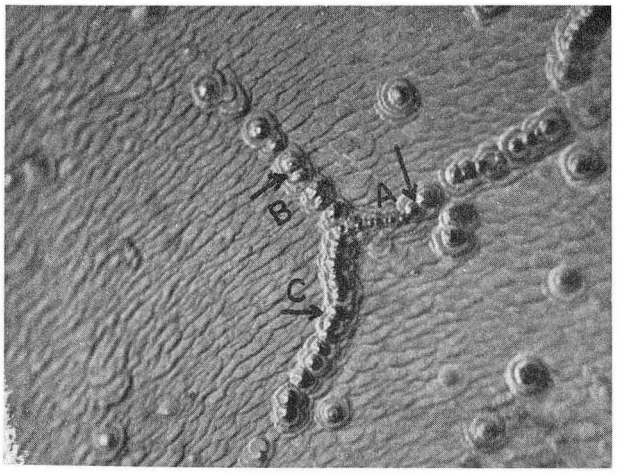

FIG. 3 ETCH PITS IN INTERSECTING BOUNDARIES. (X500). (SEE TABLE I.)

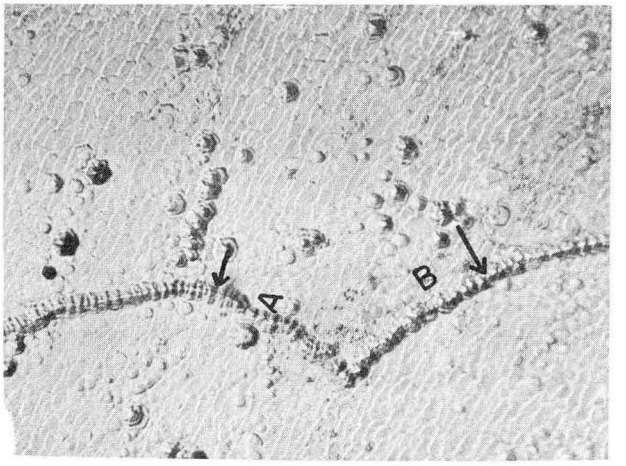

FIG. 4 ETCH PITS IN INTERSECTING BOUNDARIES. (X500). (SEE TABLE I.)

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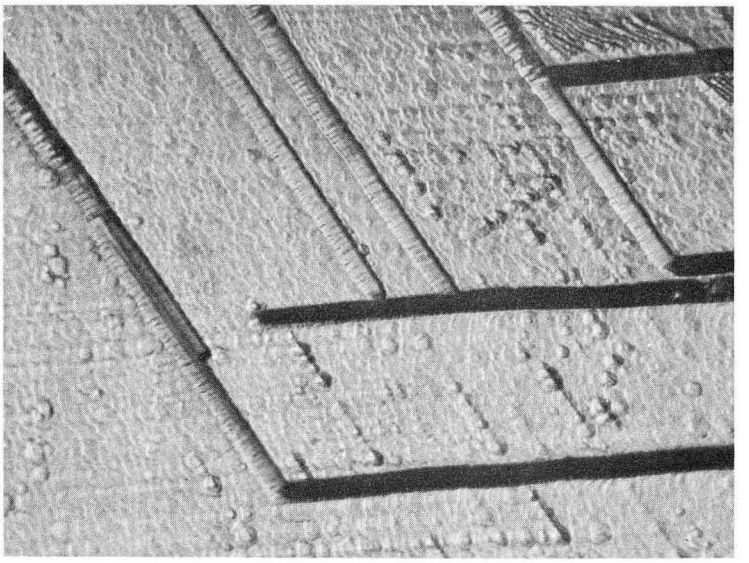

FIG. 5 ETCH PITS ALONG SLIP TRACE.
(X 500).

ZN-3835

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