SOLID STATE STUDIES IN CERAMIC ALLOYS

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Research Institute for Advanced Studies
(Martin Company)
1450 S. Rolling Road
Baltimore, Maryland 21227

Principal Investigator: John D. Venables

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It was suggested in the last report that the faults observed in TiC containing 100 p.p.m. of boron probably serve as nucleation sites for the "Mondrian" precipitate observed by Williams (J. Appl. Phys. 32, 552 (1961)) in more heavily doped (~ 0.1% boron) material. In order to identify these precipitates, and to determine what relationship exists between the faults and precipitates, an electron microscope investigation has been made on samples containing approximately 0.1% boron.

The thinning techniques which were employed for the pure and lightly doped specimens would not suffice for the heavily doped material. Ordinarily the samples are thinned by electropolishing in a mixed acids solution after a dish-shaped cavity has been introduced by jet etching. In the heavily doped material, however, the electropolishing operation preferentially removed the precipitates from the thinned sections. In view of this, a non-preferential method of thinning was developed which allowed retention of the particles. Thinning was carried out in a two-step process. An oxide film was first formed on the sample by anodizing in an appropriate solution. The film was then removed in concentrated hydrofluoric acid. This process was then repeated until breakthrough occurred.

The examination of heavily doped material has revealed that the precipitates are indeed related to the faults. It is inferred from the observations that the growth or thickening of the precipitate platelets is accomplished by new faults being formed repeatedly on planes parallel

and adjacent to the original faults. Thus it is observed that the precipitates are bounded by many partial dislocations -- each partial bounding a faulted region.

It was possible to obtain a selected area diffraction pattern from one of the precipitates. The pattern consists of a series of streaks (rather than spots) as would be expected from a platelet approximately 50Å in thickness. The center of gravity of the streaks however corresponds exactly to the position of spots that would be produced by the compound TiB_2. In addition, the orientation of the streak pattern with respect to the matrix pattern suggests a very simple epitaxial relationship between the TiB_2 and TiC as follows:

$$[0001]_{TiB_2} \parallel [111]_{TiC}$$

and

$$[\bar{1}2\bar{1}0]_{TiB_2} \parallel [110]_{TiC}.$$

This study indicates that TiB_2 precipitates do form in boron doped TiC and, significantly, that nucleation occurs at dissociated dislocations and is therefore heterogeneous. The number of precipitates should therefore depend upon the original dislocation density.

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Erratum: In the first report it was stated that the faults observed in TiC were intrinsic in nature. This statement is in error. A subsequent

review of the diffraction data indicates that the faults are actually extrinsic, and are probably formed by the reaction

$$\frac{1}{2}\,[1\bar{1}0] \longrightarrow \frac{1}{3}\,[1\bar{1}1] + \frac{1}{6}\,[1\bar{1}\bar{2}]$$

rather than that suggested in the report. This error has been corrected in the manuscript sent to physica status solidi.