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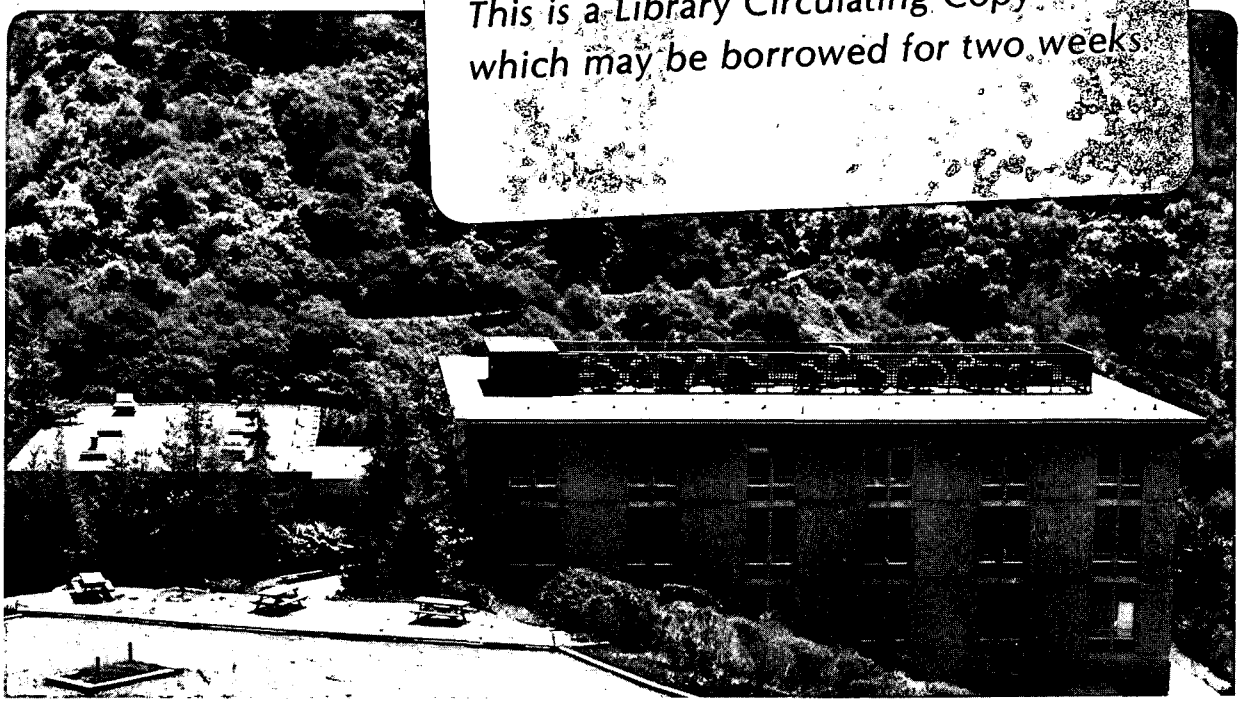

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IN SITU HREM OBSERVATION OF INTERPHASE BOUNDARY MOTION IN 95PB-5SN SOLDER

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The use of solder to provide mechanical attachment and electrical interconnection for electronic packaging is widespread throughout the industry. One application for a lead-rich solder is in the IC chip/ceramic carrier connection. It is well-established that this joint is susceptible to thermal-fatigue failure and, hence, a thorough microstructural study is warranted. Previous work has shown that 95Pb-5Sn contains ß-Sn precipitates that have formed upon solidification and subsequent aging at ambient temperature. Diffraction contrast TEM demonstrated that the precipittates lie on $\{111\}_{Pb}$habit planes.[1] High-resolution electron microscopy was undertaken to establish whether or not the habit plane was faceted on the atomic level. This contribution reports on an observation of beam-induced precipitate dissolution.

The alloy and thin foils were prepared prepared as described previously[1] with the addition of a solution treatment in argon at 200°C for 24 hours and then quenched rapidly to room temperature for a time sufficient to form an equilibrium structure (~ 1 month). It was found that the foil should be immediately placed in the microscope after removal from the ion mill. An irregularly shaped precipitate was found in a relatively thin area of the foil. Drift and foil bending were severe and therefore two through-focal series were taken approximately 15 minutes apart. The beam direction was $[011]_{Pb}$ which was about 0.5°C from $[001]_{Sn}$ (additionally, $(111)_{Pb}$ //$(010)_{Sn}$).

The micrographs clearly show precipitate dissolution occuring only at the top interface and the tip. These regions of the boundary contain ledges of different sizes. The arrowed region in Fig. 1A contains ledges ~ 4 nm in height that appear to have rounded corners. Smaller ledges of ~ 0.6 nm can be seen after further heating in a thinner area of the foil (Fig. 2B). Their spacing along the boundary is of the order of 8 nm. The lower interface does not appear to contain similar ledges and has not moved during observation. In conclusion, precipitate dissolution has been observed at high-resolution to occur by a ledge mechanism.[2] A more complete discussion of this result will appear elsewhere.

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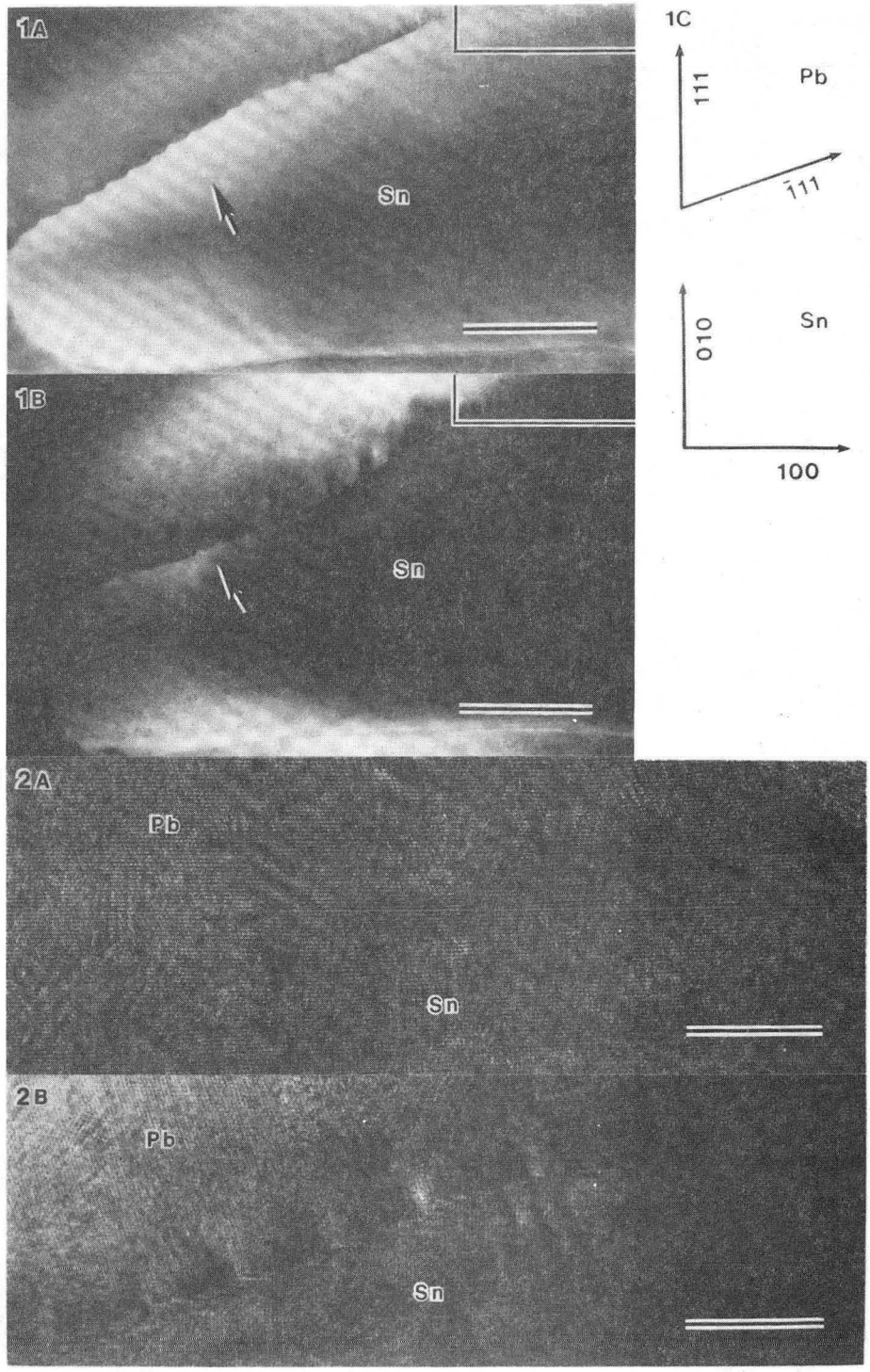

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Fig. 1.--Low magnification high-resolution of ß-Sn precipitate. (a) after ~ 20 minutes beam heating, (B) after additional 15 minutes. Bar = 75 nm. (C) schematic of crystallographic directions.

Fig. 2.--Enlargement of areas boxed in Fig. 1. Near edge of foil. Bar = 10 nm.

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