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# OBSERVATIONS OF PRECIPITATES IN 95Pb-5Sn SOLDER

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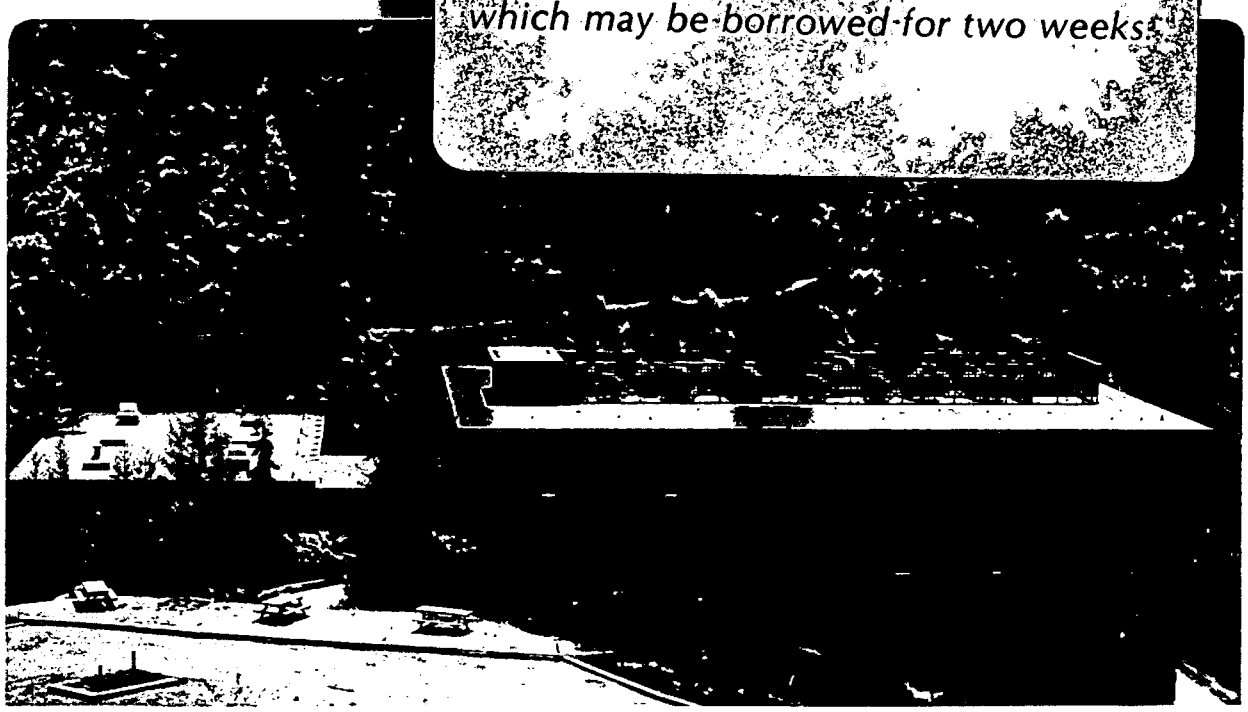

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# OBSERVATIONS OF PRECIPITATES IN 95Pb-5Sn SOLDER

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# OBSERVATIONS OF PRECIPITATES IN 95PB-5SN SOLDER

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The electronic packaging of integrated circuit chips has been cited as the limiting factor in the performance and reliability of high speed data processing units. A very important part of the package is in the first level where solder bonds the IC chip to a ceramic carrier. The most commonly used first level solder is 95Pb-5Sn. The importance of this solder connection instigated the following fundamental study of the microstructure of 95Pb-5Sn and its precipitates.

The alloy was melted in vacuum at 400° C using 99.9% pure Pb and Sn. The ingot was allowed to cool and age for a few days at room temperature. TEM 3mm foils were cut and mechanically thinned down to 4 mil thickness. After aging at room temperature the solder is considered to be in its equilibrium state, no further changes in microstructure are observed.[1] Electropolishing to perforation was performed using 80% Glacial Acetic acid with 20% Perchloric acid at 3 volts. Final thining and oxide removal was performed using the cold stage ion will at 5 KeV and 0.5 mA. The problem of viewing through the high atomic number of the solder was lessened by using the Kratos 1.5 MeV HVEM at the National Center for Electron Microscopy at Berkeley. A 1.5 MeV accelerating voltage allowed greater penetration depth and large thin areas in the foil were obtainable.

Figure 1 shows an optical micrograph of 95Pb-5Sn solder. There is an even distribution of discrete precipitates. This is in contrast to previous work that found the body centered tetragonal β Sn precipitates out in continuous plates in the Pb matrix.[2,3] Figure 2 shows a TEM micrograph of the β Sn precipitates. The precipitates have the morphology of small plates. An edge on view of a precipitate is found in Fig. 3. The precipitate lies on a {111} habit plane of the matrix. A preliminary orintation relationship of the β Sn precipitate in the α Pb matrix is diagrammed in Fig. 4. The relationship of the diffraction pattern is found to be $[001]_\alpha // [010]_\beta$ with the $(020)_\alpha$ misoriented 10° away from $(101)_\beta$. The interfacial dislocations shown in Fig. 3 give evidence that the β Sn precipitate has a semicoherent fit in the matrix. The semicoherent fit of the precipitates with the matrix allows precipitation hardening to occur. This would act to compenstate for the strength decrease when the Sn leaves the solid solution in forming precipitates.[1,4]

## ACKNOWLEDGMENTS

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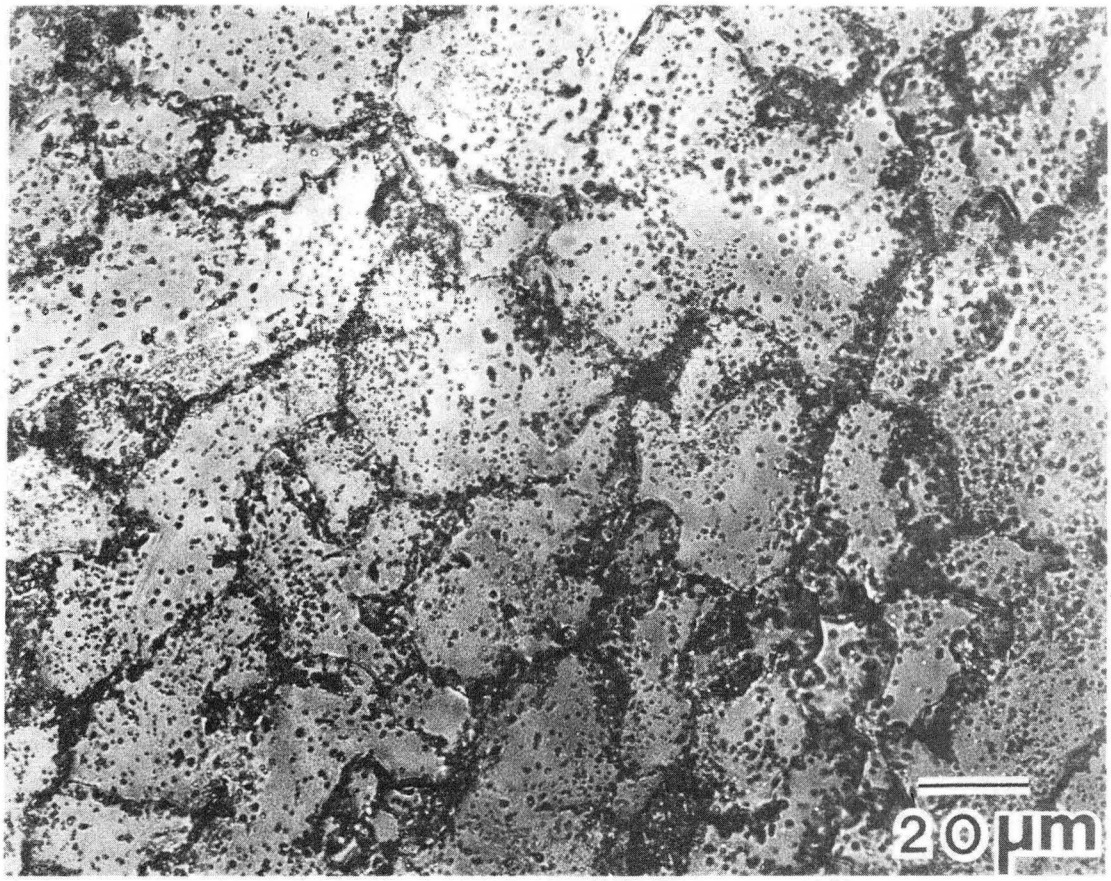


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Fig. 1 Optical micrograph of 95Pb-5Sn solder.

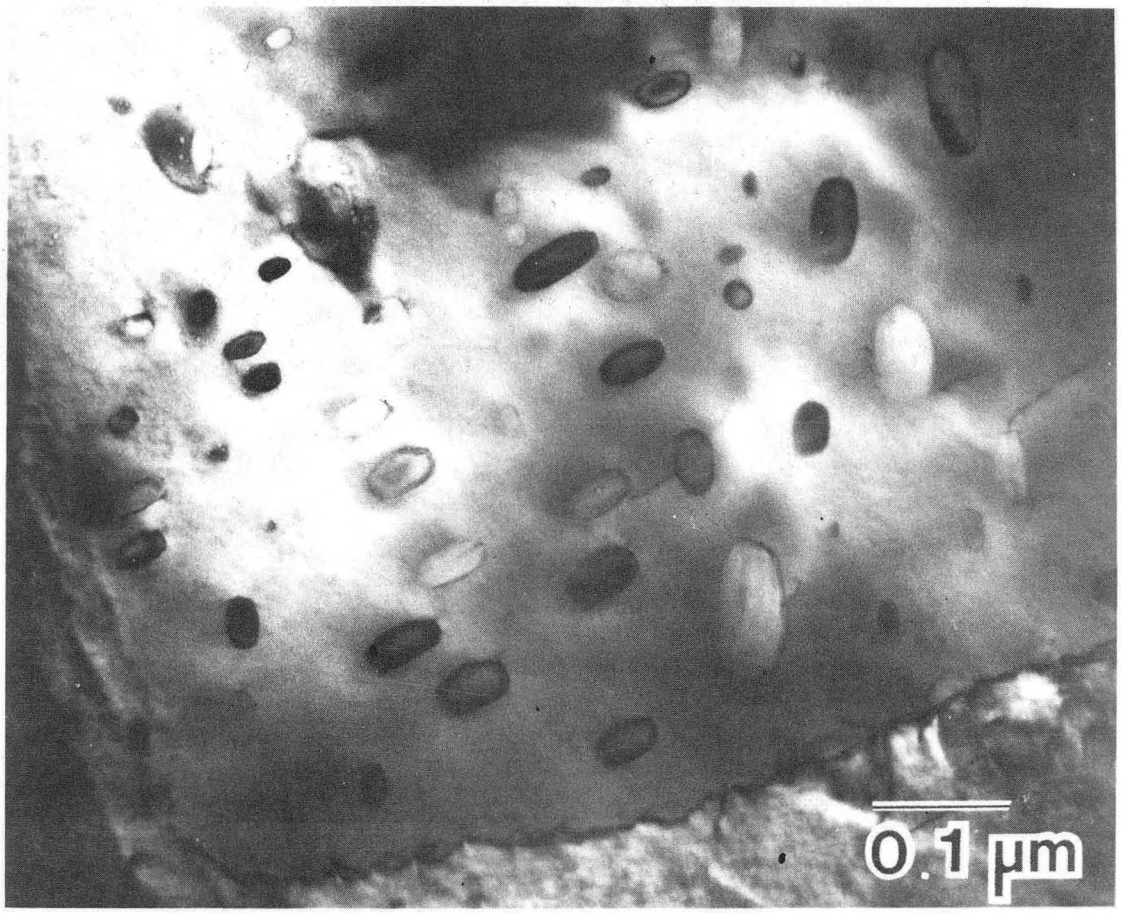


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Fig. 2 TEM image of precipitates in 95Pb-5Sn solder.

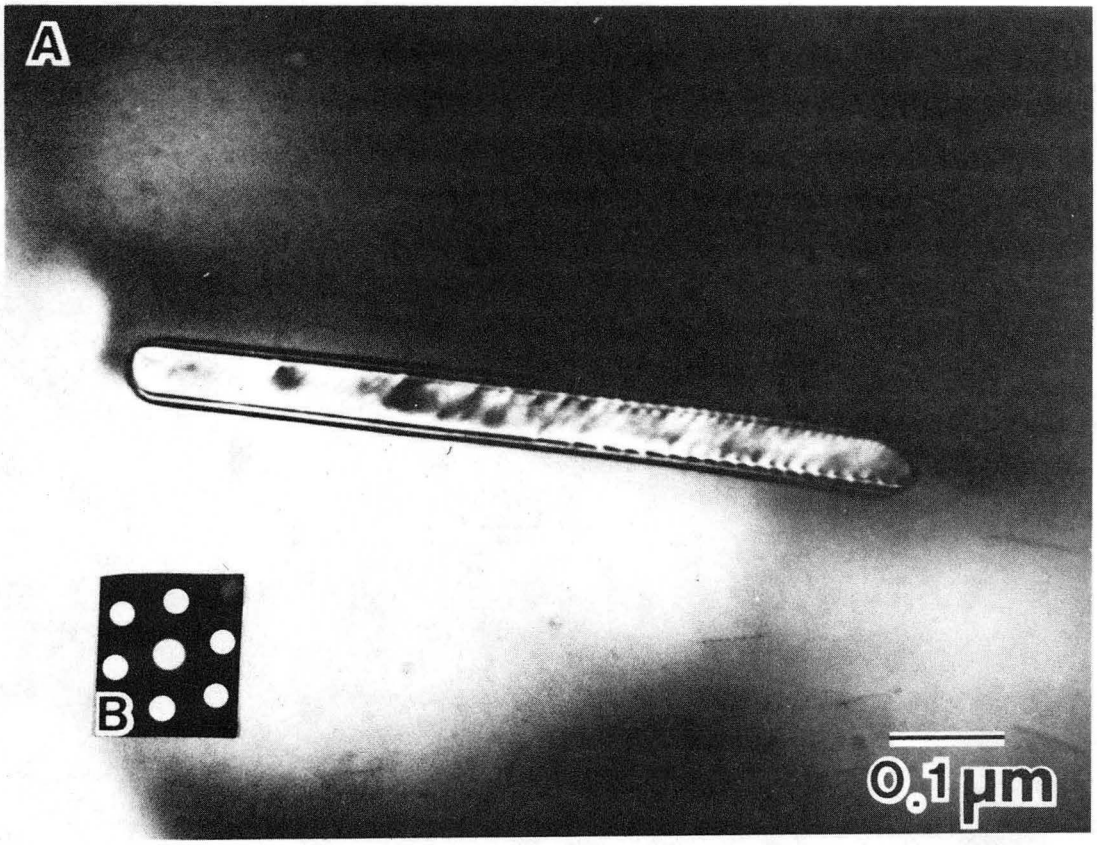


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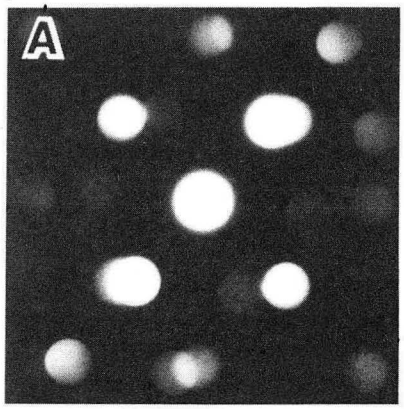
Fig. 3a. TEM image of edge on β Sn precipitate.
3b. [110] SAD pattern showing the orientation of the matrix.



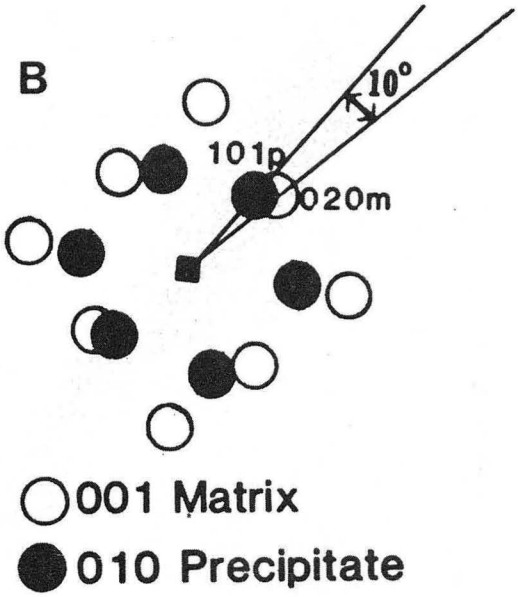




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Fig. 4a. SAD pattern of a precipitate/matrix interface.
4b. Indexed pattern of 4a.

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