Microstructural characterization of the Al-1%Si bonding wire

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Al-Si bonding wires are used for interconnection of chips in microelectronic packages such as RF power transistors. Generally, in order to ensure that uniform high quality Al-Si bonding wires can be obtained, about 1% Si is added to high purity aluminum for strengthening[1]. The microstructural properties of wire can be expected to be much different from bulk materials. Therefore, the microstructural properties can be directly related to the reliability, one of the important characteristics of the bonding wires[2].

As part of the reliability of Al-Si bonding wires used for microelectronic packages, the crystallography and morphology of nano-sized secondary phases have been investigated in an annealed specimen of conventional TEM and HREM. Specimens for observations were made by two different methods one is parallel to the drawn direction (D.D.), and the other one is perpendicular to the drawn direction (T.D.), respectively. The grains are extremely long and thin parallel to the drawn direction, and the average grain size perpendicular to the drawn direction is about 600~700 nm.(Fig. 1) Plate-like Si crystals with a length of about 10 nm and the apparent thicknesses of the few monolayers are observed.(Fig. 2) This can provide more reliable mechanical properties during bonding processing.

References

[1] H. S. Rosenbaum, D. Turnbull, Acta Metall 7 (1959) 664.
[2] G. G. Harman, Wire Bonding in Microelectronics, McGraw-Hill, New York, 1997.
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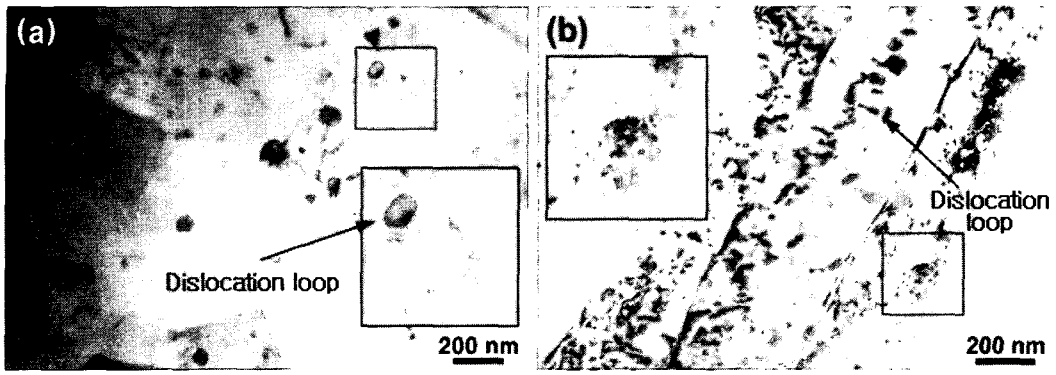

Fig. 1. Bright-field images of (a) the D.D. cross-sectional view of a wire thinned by ion milling, and (b) T.D. cross-sectional view.

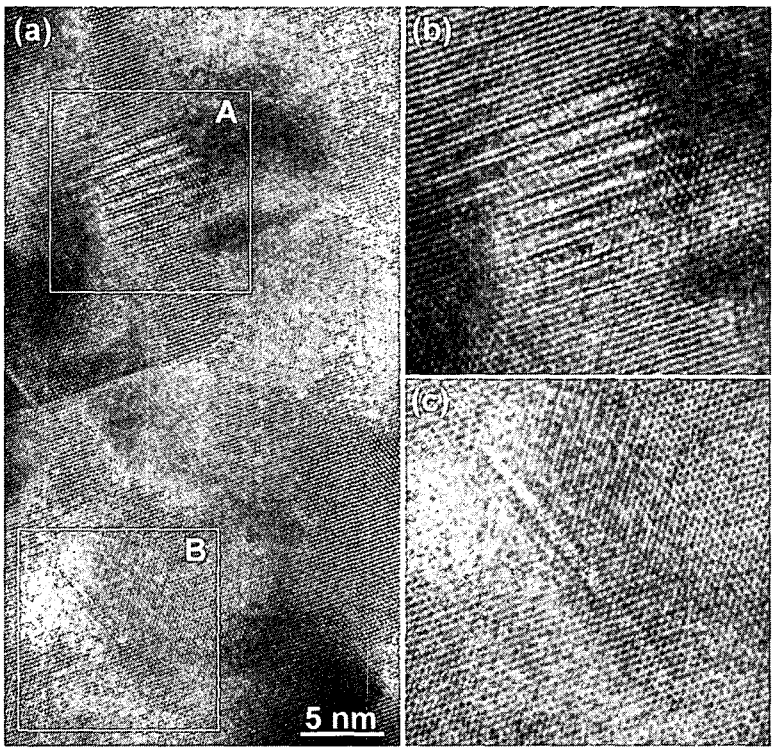

Fig. 2. (a) HREM image of an annealed specimen. A moiré fringes region (A) and a small area with white contrast (B) can be seen. (b) Enlarged image of the moiré fringe region formed by interference between Al and Si phase precipitate reflections, corresponding to the white rectangular region A in Fig. 2(a). (c) Enlarged image of the plate-like strain contrast features, corresponding to the white rectangular region B in Fig. 2(a).