ABSTRACT

The deleterious effects of discontinuous precipitation (DP) on the properties of many alloys have provoked this study on two model systems, i.e., Pb-Sn and Cu-Ag, with a view to get a better insight of the reaction kinetics and mechanism. Transformations in three binary Pb-Sn alloys, namely, alloy A, B and C containing 8.82, 9.87 and 14.57 at.% Sn, respectively, have been studied by electrical resistivity and metallography. The results show reasonable agreement with the previous studies reported in the literature. A resistivity method for determination of the highest temperature for DP proposed here yields the metastable solvus line below which DP can occur. The solute supersaturation ΔC_{DP} necessary for DP seems to increase with the initial solute content of the alloy C_o; although ($\Delta C_{DP}/C_o$) is apparently independent of C_o. Formation of nonspherical clusters with an activation energy of 36.5 kJ/mole appears to precede the DP in alloy A. Repeated freezing tends to delay the onset of DP in alloy A. The pulse heating/cooling experiments have not supported any diversity between the structure of mobile and static boundaries. In contrast to DP, the discontinuous dissolution cannot be conveniently studied by the resistivity technique.

Studies on Pb-Sn alloys containing traces of Cd or Sb show marked retardation of DP, eventhough T_{DP} remains unaffected. The effects are attributed to the grain boundary segregation of these elements, which may exert a solute drag on the migrating reaction fronts.

Metallographic investigation backed up by scanning electron microscopy on DP in a Cu-7.73 at.% Ag alloy at 400°C reveals that the eutectic-matrix interface or strain-free surface does not act as the initiation site for DP, while discontinuous reaction fronts can nucleate newer colonies. Results of Ag and Cu coating on strain-free specimens indicate that the availability of grain boundaries, rather than ease of nucleation of Ag-rich precipitates, may be crucial for the colony initiation. A very fast rate of colony growth in the scratch-strained region of the specimens in the early stage (<30 min.) of precipitation cannot be explained simply by the increase in the driving force. The growth velocity at the later stage (≥30 min.) seems to increase marginally with the increase in scratching load above 10 kg.