Rates of Dissolution of Rotating Cobalt Cylinders in Liquid Copper and Cu-Co Alloys

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Abstract

Cobalt cylinders having the top and bottom faces capped with molybdenum were rotated at the speeds of 260, 600, and 860 rpm in liquid copper and Cu-Co alloys maintained at 1200, 1270, and 1340°C under argon at 1 atm. pressure. The dependence of the dissolution rate of the cylinders on the concentration of cobalt in the bulk liquid was observed. The solution-rate constants defined by a modified form of the Berthoud equation varied from 6.6×10^{-3} to 2.7×10^{-2} cm·sec^{-1}. The activation energies for the dissolution processes at the rotational speeds of 260 and 600 rpm were 12.7 and 13.7 kcal·mol^{-1}, respectively. The rate constant was found to vary with the 0.76 to the 0.94 power of the Reynolds number in the range $5.7\times10^{4}<\mathrm{Re}<2.1\times10^{4}$. The dependence of the dissolution rate on the activity of cobalt in the bulk liquid was observed and was discussed on the basis of the thermodynamic expression for diffusion. The results of this investigation suggest that the dissolution process is diffusion controlled. Oxygen increases markedly the dissolution rate.

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