

Diffusion in Intermetallic Compounds and Fabrication of Hollow Nano-particle through Kirkendall Effect

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In intermetallic compounds, random vacancy motion is not possible as it would disrupt the equilibrium ordered arrangement of atoms on lattice sites. In view of this limitation, various atomistic models have been proposed, which allow atom-vacancy exchanges to take place without concomitant long range disordering. For $L1_2$ -type A_3B structure, the major element A diffuses faster than the minor element B. The trend is attributed to the different diffusing paths; A atoms can diffuse through site exchanges with a neighbouring vacancy on its own sublattice, while the jump of a B atom to a neighbouring site always creates wrong bonds. For $L1_0$ -type structure such as γ -TiAl, significant diffusion anisotropy is observed; Ti atoms diffuse on the Ti sublattice, while Al atoms also diffuse on the Ti sublattice. The formation of hollow metal oxide nanoparticles through the oxidation process has been studied by transmission electron microscopy for Cu, Ni and Al. The hollow structure is obtained as a result of vacancy aggregation, resulting from the rapid outward diffusion of metal ions through the oxide layer during the oxidation process. This suggests the occurrence of two different diffusion processes in the formation of hollow oxides.