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Interdiffusion along grain boundaries – Diffusion Induced Grain Boundary Migration, low temperature homogenization and reactions in nanostructured thin films

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Abstract

Interdiffusion along grain boundaries can lead to shift of grain boundaries in form of Grain Boundary Diffusion Induced Grain Boundary Migration, DIGM, in systems forming wide range solid solutions, and to the Grain Boundary Diffusion Induced Solid State Reactions, in systems containing intermetallic phases. If, during above processes, the grain size of the sample is smaller than the double of the migration distance complete homogenization can also be reached (cold homogenization). Atomic mechanisms and phenomenological description of such alloying are reviewed. The main driving force, at low temperatures where the bulk diffusion is completely frozen out, arises from the unequality of the grain boundary atomic fluxes, leading to stress accumulations. The cold homogenization is the manifestation of such stress relaxations. Reviewing experimental data, we illustrate that DIGM takes place on both sides of a binary AB thin film and the solute content in the DIGM zone is higher on the side of the component of higher melting point (i.e. in the slower component). In binary systems containing intermetallic compounds the cold homogenization can lead, either to the formation of a given stoichiometric compound, or to two phase equilibrium, in