Interdiffusion Studies in Multicomponent High Entropy Alloys

Anuj Dash, Neelamegan Esakkiraja and Aloke Paul

Department of Materials Engineering, Indian Institute of Science, Bengaluru, India 560012

In this presentation, the benefits of following the pseudo-binary and pseudo-ternary diffusion couple methods for the estimation of interdiffusion, intrinsic and tracer diffusion coefficients in a multicomponent system will be demonstrated. First, a set of pseudo-binary diffusion couples are produced to estimate the composition-dependent interdiffusion coefficients over the whole composition range of the diffusion couples and the intrinsic diffusion coefficients of all the components at the Kirkendall marker plane located near equiatomic composition in the NiCoFeCr system. Following, the calculation of the tracer diffusion coefficients is demonstrated from the estimated intrinsic diffusion coefficients and thermodynamic parameters. The role of vacancy wind effect is found to be negligible in the pseudo-binary Ni-Co (fixed Fe, Cr) and Fe-Cr (fixed Ni, Co) diffusion couples. The data estimated show an excellent match with the tracer diffusion coefficients available in the literature, which are measured by the radiotracer method. Subsequently, the pseudo-ternary diffusion couples are produced, which intersect almost at the equiatomic composition. The estimated diffusion coefficients and the diffusion profiles indicate a favourable diffusion interaction when Ni and Co diffuse in the same direction but opposite to Fe. The estimated tracer diffusion coefficients and the interdiffusion coefficients in pseudo-binary diffusion couples again show an excellent match with the interdiffusion coefficients in pseudo-ternary diffusion couples.