19th INTERNATIONAL CONFERENCE ON DIFFUSION IN SOLIDS AND LIQUIDS
DSL2023
HERAKLION, CRETE | GREECE
26-30 JUNE 2023

ABSTRACT:

Determination of Full Set of Diffusivities by Intersecting Similar and Dissimilar Diffusion Paths in A Multiprincipal Element Alloy

A. Dash1, S. Bhattacharya2 and A. Paul1

1Department of Materials Engineering, Indian Institute of Science, Bangalore, India
2Materials Science and Metallurgical Engineering, IITH, Sangareddy, India

Quantitative diffusion analysis in multicomponent metallic systems has been a formidable task historically and despite decades of research, most of the diffusivity estimations were limited to interdiffusion and some intrinsic diffusion coefficients in binary systems and interdiffusion coefficients in a few ternary systems until recently. Recently, several newly proposed methods like the pseudo-binary, pseudo-ternary and the body diagonal method help ease the determination of the interdiffusion coefficients and a limited number of intrinsic coefficients in multicomponent systems. This work extends these PB, PT and body diagonal methods to determine the intrinsic coefficients and the tracer coefficients of all the diffusing components in the respective methods. This work then explores the possibilities of taking advantage of the constrained nature of these diffusion paths by crossing dissimilar constrained diffusion paths at a desired composition. Strategically crossing a rectilinear pseudo-binary diffusion path with a serpentine conventional (body diagonal) diffusion path overcomes all the previous drawbacks of pseudo binary, pseudo ternary and body diagonal methods to determine the full set of diffusivities at any desired composition and generalizes the constrained diffusion path approach to any order multicomponent system. Application of these methods to the NiCoFeCr equiatomic model system shows a good match between the estimated tracer data from these approaches and the tracer coefficients obtained from radio tracer experiments.