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ABSTRACT

Combined Measurement of Tracer, Impurity, and Intrinsic Diffusion Coefficients with Atomic Correlation Factors in a Binary Diffusion Couple

N. Esakkiraja[1], J. Berndt[2], S. Klemme[2], G. Wilde[1], A. Paul[3] and S.V. Divinski[1]

[1]Institute of Materials Physics, University of Muenster, Germany
[2]Institute of Mineralogie, University of Münster, Germany
[3]Department of Materials Engineering, IISc Bangalore, India

A fundamental understanding of atomic diffusion is essential for advancing the application of multi-component alloys. The augmented tracer-interdiffusion couple approach enables the determination of composition-dependent tracer diffusion coefficients (mobilities) along the entire diffusion path. This study introduces a novel methodology for calculating vacancy flux in diffusion couples, significantly expanding the range of accessible diffusion parameters beyond interdiffusion coefficients. We have demonstrated that this approach can reliably estimate composition-dependent thermodynamic factors and Manning's factors. Additionally, for the first time, we determine the composition-dependent correlation factors of diffusing elements within a diffusion couple. A modified tracer-interdiffusion couple approach is employed to estimate the composition-dependent impurity diffusion coefficients by incorporating suitable radiotracers at the Matano plane. Furthermore, Onsager coefficients are evaluated across the entire concentration range under investigation. In the Ni–Fe diffusion couple, under the influence of vacancy flux, Co, Cr, and Mn atoms exhibit a bias towards the Ni-rich side, with Mn atoms showing the most pronounced vacancy flux-driven drift.