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Diffusion Couple Experiments: Opportunities and Challenges in Determining Thermo-Kinetic and Functional Properties

Yongho Sohn

University of Central Florida, Orlando, FL, 32816-2455, USA

Understanding of solid-state diffusion through experiments has played many critical roles in materials and surface engineering for a variety of applications. Historically these experiments were carried out and analyzed to determine coefficients of diffusion kinetics and extract additional thermodynamics information (e.g., thermodynamics factor and phase equilibria). Given the ability of diffusion to explore composition-temperature axes, this simple experimental procedure can expand to assess functional materials properties beyond thermo-kinetic parameters.

In addition to more innovative theoretical development for high-throughput determination of thermo-kinetic coefficients [1,2], advances in materials characterization tools such as focused ion beam and micro-manipulators has allowed micron scale sampling of materials. Coupled with advances in measurement instrumentation, functionally important properties such as physical [3] (crystallography), mechanical [4,5] (strength, modulus, hardness), thermal [6,7] (conductivity, expansion coefficients) properties can be determined from material samples extracted from diffusion couple experiments.

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7. X. Zheng et al., *J. App. Phys.*, 104 (2008) 073509.