High-throughput experimental measurements for reliable establishment of materials databases and for accelerated alloy design

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Abstract

This talk will review some recent advances in high-throughput experimental techniques for rapid collections of materials property data for simulations of materials properties. Localized property measurements on composition gradients created in diffusion multiples allow effective collection of composition-dependent properties, including thermal conductivity, heat capacity, coefficient of thermal expansion, and elastic constants. A newly developed forward-simulation analysis allows accurate measurement of impurity (dilute) diffusion coefficients from regular diffusion couple profiles without using isotope tracer experiments. The impurity diffusion coefficients together with interdiffusion coefficients are essential to the establishment of diffusion (mobility) databases for modeling the creep properties of materials and precipitation processes. Recent development of dual-anneal diffusion multiples (DADMs) allow rapid and systematic collection of phase precipitation kinetics and morphological evolution data across wide ranges of compositions as a function of time and temperature, creating large datasets for validation and testing of model simulations.

Brief Bio.

Dr. Ji-Cheng (JC) Zhao, Fellow of both ASM International and MRS, joined University of Maryland (UMD) on July 1, 2019 as a Minta Martin Professor and Department Chair of Materials Science and Engineering (MSE). Before UMD, he was a professor at the MSE Department at The Ohio State University (OSU) for about ten years (1/2008 to 6/2019). Prior to OSU, he was a materials scientist and project/team leader at GE Global Research Center in Schenectady, NY for 12 years (1995 to 2007). He took a leave from OSU from 2014 to 2017 to serve as a Program Director at the Advanced Research Projects Agency-Energy (ARPA-E). His research focuses are on high-throughput materials science methodologies, determination of phase diagrams and other materials properties, computational thermodynamics, and design of advanced alloys and coatings. In addition to many materials innovations, he pioneered the development of a diffusion-multiple approach and co-developed several materials property microscopy tools for accelerated materials discovery and development. The invention of ultrafast laser materials property microscopy by the Zhao-Cahill team was recognized as one of the eight finalists for the 2018 Berthold Leibinger Innovationspreis, the highest remunerated prizes dedicated to laser technology innovations. Zhao holds 48 issued US patents and was the 2001 winner of the prestigious Hull Award from GE Global Research with a citation “for his leadership skills in advancing innovative, state-of-the-art development methodologies that aim to decrease cycle time for materials discovery while increasing robustness of the work. He also was recognized for his expertise and leadership

regarding the critical nature of coatings and high temperature materials, and for his enormous energy and perseverance in solving real business challenges." One of the alloys he co-invented is widely used in GE electricity-generation gas turbines. Zhao was recently elected to serve on the Board of Trustees of ASM International for the 2019-2022 term.