Deviation from High-Entropy Configurations in the Atomic Distributions of a Multi-principal-element Alloy

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ABSTRACT

The alloy-design strategy of combining multiple elements in near-equimolar ratios has shown great potential for producing exceptional engineering materials, often known as "high-entropy alloys". Understanding the elemental distributions, and, thus, the evolution of the configurational entropy during solidification, are the goal of the present research. The case of the $Al_{1.3}CoCrCuFeNi$ model alloy is examined, using integrated theoretical and experimental techniques, such as *ab initio* molecular-dynamics simulations, in-situ neutron levitation and scattering experiments, synchrotron X-ray diffraction, high-resolution electron microscopy, and atom-probe tomography. It is shown that even when the material undergoes elemental segregation, precipitation, chemical ordering, and spinodal decomposition, a significant amount of disorder remains, due to the distributions of multiple elements in the major phases. The results suggest that the high-entropy-alloy-design strategy may be used to develop a wide range of complex materials, which are not limited to single-phase solid solutions. The integrated experimental and theoretical techniques, discussed here, are particularly well-suited to studying partially-ordered materials, produced using the high-entropy-alloy design strategy.

Santodonato LJ, Zhang Y, Feygenson M, Parish CM, Gao MC, Weber RJK, Neuefeind JC, Tang Z, Liaw PK. (2015) Deviation from high-entropy configurations in the atomic distributions of a multi-principal-element alloy, Nature Communications, 6:5964. doi:10.1038/ncomms6964.

Acknowledgements: PKL very much appreciates the financial support from the US National Science Foundation (CMMI-1100080 and DMR-1611180), the Department of Energy (DOE), Office of Nuclear Energy's Nuclear Energy University Program (NEUP) 00119262, the DOE, Office of Fossil Energy, with the National Energy Technology Laboratory (DE-FE-0008855 and DE-FE-0024054), and the U.S. Army Research Office (W911NF-13-1-0438), with C. Huber, C. V. Cooper, D. Farkas, A. Ardell, E. Taleff, V. Cedro, R. Dunst, R. O. Jensen, L. Tan, S. Lesica, S. N. Mathaudhu, and D. M. Stepp as contract monitors. KAD gratefully acknowledges the NSF grants of DMR-1005209 and DMS-1069224. PKL and KAD are grateful to the DOE, Office of Fossil Energy (DE-FE-0011194) with S. Markovich and J. Mullen as contract monitors. YZ very much appreciates the financial support from the National Natural Science Foundation of China (Nos. 51010001 and 51001009), 111 Project (B07003), and the Program for Changjiang Scholars and the Innovative Research Team of the University.

Short Biography: Peter K. Liaw was born in Chiayi, Taiwan. He graduated from the Chiayi High School, obtained his B.S. in Physics from the National Tsing Hua University, Taiwan, and his Ph.D. in Materials Science and Engineering from Northwestern University, USA, in 1980.

After working at the Westinghouse Research and Development (R&D) Center for thirteen years, he joins the faculty and becomes an Endowed Ivan Racheff Chair of Excellence in the Department of Materials Science and Engineering at The University of Tennessee (UT), Knoxville, since March 1993. He has been working in the areas of fatigue, fracture, nondestructive evaluation, and life-prediction methodologies of structural alloys and composites. Since joining UT, his research interests include mechanical behavior, nondestructive evaluation, biomaterials, high-temperature alloys, bulk metallic glasses, high-entropy alloys, ceramic-matrix composites and coatings with the kindest and greatest help of his colleagues at UT and the near-by Oak Ridge National Laboratory. He has published seven hundred and eighty-six journal papers, edited more than thirty books, and presented numerous keynote and invited lectures at various national and international conferences, universities, and industries.

He was awarded the Royal E. Cabell Fellowship at Northwestern University. He is a recipient of numerous "Outstanding Performance" awards from the Westinghouse R&D Center. He was the Chairman of the TMS (The Minerals, Metals and Materials Society) "Mechanical Metallurgy" Committee, and the Chairman of the ASM (American Society for Metals) "Flow and Fracture" Committee. He has been the Chairman and Member of the TMS Award Committee on "Application to Practice, Educator, and Leadership Awards." He is a fellow of ASM. He has been given the Outstanding Teacher Award, the Moses E. and Mayme Brooks Distinguished Professor Award, the Engineering Research Fellow Award, the National Alumni Association Distinguished Service Professor Award, the John Fisher Professorship, and L. R. Hesler Award at The University of Tennessee, and the TMS Distinguished Service Award.

He has been the Director of the National Science Foundation (NSF) Integrative Graduate Education and Research Training (IGERT) Program, the Director of the NSF International Materials Institutes (IMI) Program, and the Director of the NSF Major Research Instrumentation (MRI) Program at UT. Several of his graduate students have been given awards for their research and presentations at various professional societies and conferences. Moreover, his students are teaching and doing research at universities, industries, and government laboratories.