Abstract: Transitional metal carbides comprise a class of high and ultrahigh melting temperature materials with tremendous thermo-mechanical property potential. Depending on temperature and phase type, brittle behavior to significant plasticity responses can be observed. By tailoring the phase fraction within each carbide, opportunities for benchmark improvements in thermo-mechanical performance can be achieved through microstructural engineering. This seminar will address the underlying phase stability behavior in these carbides and how crystallography controls microstructure and deformation mechanisms. In particular, a first principle ab initio investigation will be discussed that revealed a competition between vacancy-ordered and fault forming phases in the group VB metal carbides, with the latter phases becoming more favorable with decreasing carbon content. This competition is less favorable in the group IVB metal carbides due to their inability to yield a stable intrinsic stacking fault on the close packed planes. The consequences of these phases (and the intrinsic stacking fault) on the deformation slip systems is discussed in terms of the mix metal-carbon and metal-metal bonding environments in the unit cells. The computational results are connected to experimental dynamical electron diffraction experiments to validate and verify the deformation mechanisms and energy hierarchy of such slip behavior.

Biography

Professor Gregory B. Thompson joined the faculty in the Department of Metallurgical & Materials Engineering at The University of Alabama as an Assistant Professor in 2003. He was tenured and promoted to Associate Professor in 2008 and promoted to Professor in 2012. He currently serves as the Associate Director for UA’s Central Analytical Facility, which houses over $10M of analytical microscopy equipment (www.caf.ua.edu), and Director of the Materials Science PhD program on the UA campus. Professor Thompson has published over 150 peer-reviewed articles in his research areas of analytical microscopy and phase transformations. He received his Ph.D. (2003) and M.S. (1998) from The Ohio State University in Materials Science & Engineering and a B.S. (1996) in Physics from Brigham Young University. Between his M.S. and Ph.D., he worked as a process engineer for Multi-Arc Inc.’s Southeast Regional Coatings Center, which provided hard coatings for cutting tool applications. He is an active member of the Microscopy Society of America, The Minerals, Metals and Materials Society (TMS) and the Materials Research Society (MRS). Professor Thompson was the recipient of the National Science Foundation Early Career Award in 2005 and TMS’s Young Leader and International Young Leader awards in 2005 and 2008, respectively. Most recently he was awarded the Blackmon-Moody Outstanding Professor of the Year for The University of Alabama in 2014 and was a TMS Brimacombe medalist in 2017.