Materials Design for Thermal and Environmental Barrier Coatings for Next-Generation Alloys and Composites

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Thermal and environmental barrier coatings (T/EBCs) are used to protect metal and ceramic composite structural components used in the hot section of turbine engines. Recent advances in the design of alloys and composites with higher temperature capability necessitate new T/EBC materials and architectures to meet inter-related (and often competing) performance criteria. We will first discuss the application of thermo-mechanical analysis to screen candidate architecture and property space to identify viable architectures and priorities for new material development. We will then discuss progress in identifying new composite coating materials based on combinations of rare earth zirconates and aluminates that could fill property gaps. Experimental screening shows that some phase assemblages sinter quickly while others yield remarkable high-temperature microstructure stability, and that this behavior can be tuned by controlling the average rare earth cation size in systems based on mixed rare earth oxides. We will conclude by discussing consideration for the durability of coatings based on these materials in complex service environments, and the application of these insights to guide next-generation T/EBC design.

Biosketch: David L. Poerschke is an Associate Professor in the Department of Chemical Engineering and Materials Science at the University of Minnesota. His research seeks to understand the coupled thermodynamic and kinetic processes controlling the structural evolution and performance of multi-phase and composite systems in complex chemical, thermal, and mechanical environments. His group applies these insights to accelerate the discovery of new materials for service in extreme environments. He is a recipient of an NSF Faculty Early Career Development (CAREER) award and ONR Young Investigator Program (YIP) award. Prior to joining UMN in 2017, he earned his Ph.D. as an NDSEG Fellow in the Materials Department at the University of California Santa Barbara and holds B.S. and M.S degrees in materials science and engineering from Case Western Reserve University.