PROCESSING, PROPERTY-STRUCTURE CHARACTERIZATION, AND COMPUTATIONAL CAPABILITIES FOR UHTC COLLABORATIVE INTERACTIONS

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The “materials science tetrahedron” of processing-structure-properties-performance requires a fundamental understanding of material interactions. To this end, linkages that bridge experimental and modeling/simulations is essential. This poster highlights a variety of processing, characterizing, and the modeling techniques for understanding materials, particularly ultrahigh temperature ceramics (UHTCs). For innovative processing, laser chemical vapor deposition is presented where fibers from a precursor gas are grown through a directed laser energy method. Other processing capabilities for making bulk (composite) materials is demonstrated with cold spray deposition and additive friction stir deposition. To assess mechanical performance in extreme environments, a unique non-contact means of thermal-mechanical loading to temperatures up to 4000 deg. C is reported. This unit provides resistive heating of a sample, and, in the presence of an electromagnetic field, a Lorentz force bends the specimen bar. Coupled with these processing and property measurements is the application of analytical microscopy that characterizes materials over 10^6 orders of magnitude of length scale. This structure and chemical analysis are achieved through atom probe tomography, transmission and scanning electron microscopy, focus ion beam imaging, and X-ray diffraction. The cooperative use of all these tools provides a synergistic interaction with computational modeling methods that reveal phase stability and deformation mechanisms in UHTCs. The impact of this collective suite of capabilities is demonstrated through various academic, national laboratories, and industrial collaborative programs.