PHASE EVOLUTION IN THERMALLY ANNEALED METALLIC-UHTC COMPOSITES

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While ultrahigh temperature ceramics (UHTCs) have melting temperatures that exceed 3000 ^{o}C and fill a niche for structural materials in extreme environments, they have limited ductility at lower temperatures that lead to catastrophic failures during initial low temperature loading. However, if the ceramic phase is embedded in a metallic matrix, these issues can be potentially alleviated, where the metal phase retains sufficient plasticity in these temperature regimes. Through a designed materials compatibility between a metal and metal carbide, lower temperature survivability can be achieved whereupon at elevated temperature a diffusional phase transformation occurs between the two phases. This yields a sub-stoichiometric carbide phase that retains the high melting temperature and strength needed in these conditions. In this work, we address the transformation behavior in a vacuum plasma spray deposit of Zr/ZrC subjected to resistive heating. Through mechanical nanoindentation and electron microscopy characterization, the rate of transformation was measured and linked to the time and temperature exposures. This information identifies key microstructural features that regulate the transformation as well as provides the framework for laminate design for phase changing metal-metal carbide composites.