ADDITIVE MANUFACTURING ENABLING W-SiC AND W-ZrB_2-SiC HETEROGENEOUS MATERIALS

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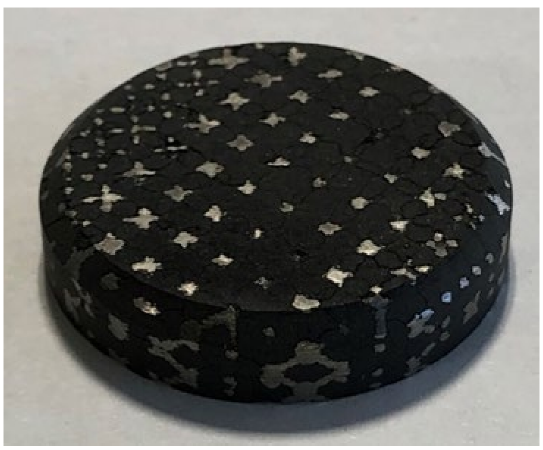
Refractory metals have high melting temperatures and densities. Ceramics have high sublimation temperatures, high temperature oxidation resistance and low densities. Both types of materials demonstrate relatively brittle failure behavior. Composites with brittle fiber and matrix materials have demonstrated that graceful failure behavior can be exhibited by combining brittle materials into a common microstructure. However, fabricating composites is typically expensive and time consuming. The goal of this research was to develop an additive manufacturing technique to form a heterogeneous microstructure comprised of high temperature capable materials that would exhibit graceful failure behavior. Refractory metal-ceramic heterogeneous materials were created via additive manufacturing and tested at high velocity flight conditions. Tungsten (W) lattices were created via e-beam laser powder bed deposition. The lattices were infiltrated with ceramic matrices using various combinations of powder, liquid and vapor processes, including polymer impregnation pyrolysis (PIP) and chemical vapor infiltration (CVI). Two types of composites were fabricated using W lattices. One type employed ZrB_2 particles for matrix infiltration and the other used SiC particles. Both types had final densification performed via CVI deposition of SiC. The microstructures and properties of the heterogeneous materials were investigated, and the results are discussed.



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