High Temperature Lightweight Self-Healing Ceramic Composites for Aircraft Engine Applications

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Abstract

The overall objective of this proposal was to develop a new class of high temperature, lightweight, self-healing, SiC fiber-reinforced engineered matrix composites (SH-EMCs). Engineered matrices (EM) consisting of silicon carbide-silicon nitride-intermetallic silicide powder mixtures, designed to match the coefficient of thermal expansion (CTE) of SiC fibers, and possessing adequate oxidation, plasticity, and thermal conductivity properties were fabricated by hot-pressing the powder mixtures. Several powder compositions were prepared and microstructural analysis, CTE, oxidation and bend tests were conducted to determine their properties to identify promising compositions for further development. As a result, a few EM compositions have been identified for low temperature (less than 1300^0 C) and high temperature ($1400\text{-}1600^0$ C) applications based on a combination of properties: Oxidation, CTE, matrix plasticity and fracture behavior. Investigations were conducted to identify suitable methods for infiltrating the powder mixtures into BN-coated SiC/SiC woven preforms and one promising technique was down selected for further process development and optimization. Computer tomography scans are currently underway to verify the extent of matrix porosity in the EMCs. Studies are also underway to fabricate bend and tensile SH-EMC specimens to study their properties.