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Fiber Architectural Effects on Impact Resistance of Uncoated and Environmental Barrier Coated MI SiC/SiC Composites

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Summary

SiC fiber reinforced SiC matrix composites (SiC/SiC) are candidate materials for next generation aerospace, power, and nuclear applications because of their high temperature strength, high creep resistance, and high thermal conductivity. Currently these composites are fabricated by three processing approaches: melt infiltration (MI), chemical vapor infiltration (CVI), or polymer infiltration and pyrolysis (PIP). To date the SiC/SiC composites fabricated by MI and by CVI are the most investigated [1]. Studies have shown that all three types of SiC/SiC composites are stable up to 1300C in air or in oxidizing environments after extended exposure times, predominantly due to growth of an adherent protective silica scale on the external surfaces. In contrast, in a combustion environment containing moisture, these composites exhibit recession due to simultaneous formation and volatilization of silica at temperatures greater than 1100C [2, 3]. To protect these composites from surface recession environmental barrier (EB) coatings have been developed [4, 5]. However, long term durability of EBC on MI SiC/SiC composite components such as nozzle vanes and blades, in the flow path of the combustion gas, under impact, corrosion, and erosion conditions has not been fully investigated. Impact damage in coated fiber reinforced ceramic matrix composites is very complex and is influenced by variety of factors such as composite constituents, fiber architecture, EB coating properties and morphology, projectile properties, test conditions, and specimen thickness. In spite of this complexity, general trends in the impact damage mechanisms and consequences of impact damage on composite performance can be determined. With this information, optimum fiber architecture and coating microstructure can be developed to improve impact resistance. Preliminary studies of single particle impact resistance of 2-D woven uncoated and EB coated MI SiC/SiC composites indicate debonding of EB coating and delamination of fiber plies in the composite