

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advanced Materials and Structures for High Temperature Applications (4)

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PROCESSING AND TESTING OF UHTCMCS FOR AEROSPACE APPLICATIONS

Abstract

Materials for thermal protection systems of space vehicles must withstand extreme temperatures and intense mechanical vibrations at launch and re-entry into the Earth's atmosphere. The combination of extremely hot temperatures, chemically aggressive environments, and rapid heating and cooling is beyond the capabilities of current materials. Ultra-high-temperature-ceramics, such as the borides and carbides of early transition metals, are a class of materials characterized by melting points exceeding 3000C, high thermal and electrical conductivities, and good ablation resistance. However, their low fracture toughness and poor thermal shock resistance pose major obstacles to their implementation. In the past few years, a new class of materials labelled UHTCMCs (ultra-high temperature ceramic matrix composites) has been developed combining a UHTC rich matrix with carbon fibres. In this talk we show the recent advancements in the manufacturing of UHTCMCs and their mechanical and environmental testing. Fibre reinforcement has been shown to improve the damage tolerance at room and elevated temperature. Optimized microstructures and textures led to exceptional ablation/erosion resistance beyond 2000C in arc jet and in rocket nozzles.