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Study of SiC fiber-matrix interaction in ultra-high temperature ceramics by transmission electron microscopy

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Abstract

In the last few years ISTEC activity has been focused on the development of toughened ultra-high temperature ceramics, in order to fill the gap of the low intrinsic fracture toughness of this class of materials. Toughness improvement from 3.5 to around 6 MPa·$m^{1/2}$ has been achieved through the addition of SiC short fibers, by varying processing methods, sintering additives, thermal treatments and type of fiber. In turn, all these parameters affect fiber integrity and the matrix/fiber interface chemistry, ultimately affecting the mechanical properties.

The aim of this study was to understand how the sintering additive or specific treatments on the fiber can control the interface fiber/matrix. Transmission electron microscopy was mainly used as fundamental technique for the characterization at nanoscale level of the fiber morphology and interface with the matrix.

A comparison between the evolution of the Hi Nicalon fiber versus the Tyranno type in ZrB_2 matrices is presented, evidencing that different thermal stability and chemical inertness may affect the local and global microstructure. Relevant mechanical properties are also reported and related to the microstructural features.