Oxidation Behavior of HfB_2-SiC and ZrB_2-SiC Ultra-High Temperature Ceramics in different air atmospheres

C. Piriou*, O. Rapaud and S. Foucaud, SPCTS-CNRS UMR 7315, Limoges, France; L. Charpentier and M. Balat-Pichelin, PROMES-CNRS UPR 8521, Font-Romeu Odeillo, France.

Ultra-High Temperature Ceramics, in particular diborides of the IVb group, are promising materials for extreme environments, more specifically for thermal protection systems of hypersonic vehicles during their atmospheric reentry at temperatures higher than 1800 °C.

The main objective of this work is to study the oxidation behavior in air of (Hf or Zr)B_2-SiC composites under severe conditions. The first stage consists in elaborating fully-dense (Hf or Zr)B_2-SiC ceramics, from 0 to 30 vol.% SiC, with similar and controlled microstructures using Spark Plasma Sintering to obtain materials with fine grains, high relative density (> 99 %) at lower temperatures and shorter dwell times. An optimization of sintering parameters has been carried out for every composition. The second step consists in understanding the oxidation mechanisms of both composites. To this end, these materials have been oxidized at several temperatures using concentrated solar energy, including the oxidation in atomic oxygen. The mechanisms have been highlighted through the study of the oxidized layers by combining XRD, SEM and Raman spectroscopy with imaging and by the monitoring of oxidation kinetics. This work was helped by a first thermodynamic approach of both systems through the modeling of ternary diagrams.

Oral presentation

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