OXIDATION BEHAVIOR OF C_f / MC – MB_2 – SiC (with M = Hf, Zr) COMPOSITES IN AN OXYACETYLENE TORCH ENVIRONMENT

Thomas Bourdeau, Université de Bordeaux, CNRS, Safran, CEA: LCTS, UMR 5801, France, thomas.bourdeau@cnrs.fr
Laurence Maillé, Université de Bordeaux, CNRS, Safran, CEA: LCTS, UMR 5801, France
Yann Le Petitcorps, Université de Bordeaux, CNRS, Safran, CEA: LCTS, UMR 5801, France
Pierre Bertrand, Université de Bourgogne Franche Comté, Laboratoire Interdisciplinaire Carnot de Bourgogne (ICB), Université de Technologie de Belfort-Montbéliard (UTBM), France
Alexandre Allemand, (LCTS, UMR 5801 / CEA Le Ripault, France
Francis Rebillat , Université de Bordeaux, CNRS, Safran, CEA: LCTS, UMR 5801, France

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The rapid development of space vehicles needs the elaboration of a new kind of materials able to resist to extreme conditions. For thermos-structural materials, the most severe conditions take place in atmospheric reentry vehicles and/or combustion chambers. Those two environments lead to the appearance of several physical and chemical reactions due to the high temperature, high flux and oxidation phenomena. One of the best candidates is the Ceramic Matrix Composites (CMCs) especially CMC with Ultra High Temperature Ceramic (UHTC) as matrix. This kind of materials presents many advantages. The melting temperature of UHTC like TaC, HfB_2, HfC or ZrC is above 2500 °C. Also, they exhibit high hardness, and good ablation resistance. The use of MC, MB_2 (with M = Hf, Zr) and SiC in this present work is determined by the fact that the elaboration is possible using Submicronic Powder Aspiration and Reactive Melt Infiltration process. At the end of elaboration, two materials structure are obtained: C_f / HfC – HfB_2 – SiC and C_f / ZrC – ZrB_2 – SiC. In terms of characterization, an oxyacetylene torch is used to simulate the atmospheric reentry conditions. To get closer to the conditions in service, the ratio oxygen/acetylene is 3.25. In this situation, the rate of oxygen in the flame combustion is 20%$_{mol}$ and an approximate 2 MW/m² flux. The objective of this study is to set light on the oxidation mechanisms (Figure 1) which take place in these conditions. The ablation rates show a better behavior of these matrices in comparison with an unmodified C/C composite. Moreover, tomography is used as a way of characterization. It allowed us a better understanding of oxidation mechanisms.

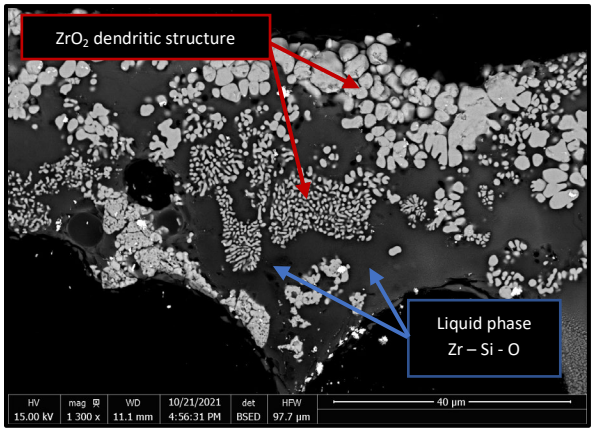

Figure 1: Oxide structure for a C_f / ZrB_2 – ZrC – SiC material showing the growing dendritic phenomena after 120s to flame exposition