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Amorphous SiO_xC_y(:Er) films deposited by RF-magnetron sputtering on ZrB_2–SiC ceramics: antioxidation and strengthening effects

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Abstract

The effect of amorphous a-SiO_xC_y(:Er) layers on the oxidation behavior of ZrB_2-SiC composite ceramics has been studied. ZrB_2–15%SiC composite samples were obtained by hot pressing of ZrB_2+15%SiC powder at 1850°C and 48 MPa. Amorphous a-SiO_xC_y:(Er) thin films (1 μm thick) were deposited on ZrB_2-SiC specimens at a temperature of 200 °C by reactive RF-magnetron sputtering of SiC/Er target in argon/oxygen flow. Coated ZrB_2-SiC samples were exposed to a high-temperature oxidation at 1400 °C for 1 hour at atmospheric pressure. Structure and phase composition were examined by optical microscopy, X-ray diffraction, SEM and EDS. It was demonstrated that a-SiO_xC_y coating noticeably enhances the oxidation resistance of the surface. Further development of the oxidation resistance was observed in Er-incorporated a-SiO_xC_y coating. Along with the improvement of the antioxidation resistance the deposition of a-SiO_xC_y(:Er) coatings resulted in increasing of bending strength of ZrB_2-SiC samples in comparison to uncoated samples. The enhancement of surface stability and strengthening by a thin a-SiO_xC_y(:Er) coating is discussed in terms of the effects of dense coating by itself and the modification of a surface silica layer by erbium incorporation as well.

Introduction

Thermal durability and antioxidation resistance at extreme temperatures are the main requirements for new materials working in extremely hot environment: ultrasonic vehicles, rocket nozzles, combustion chambers, turbine engines, etc. ZrB_2–SiC composites are well known ultrahigh-temperature ceramics with high temperature stability, high thermal conductivity and oxidation resistance. Antioxidation properties of the ZrB_2–SiC composites are commonly attributed to the formation of borosilcate surface layer that appears due to the oxidation of SiC