INVESTIGATION OF THE OXIDATION RESISTANCE OF ZrB_2-BASED MONOLITHS USING POLYMER-DERIVED Si(Zr,B)CN AS SINTERING AID

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ZrB_2 experienced extensive research as material to be used in (ultra)high temperature environments such as aerospace applications due to its high melting point, low density and thermal shock resistance. However, ZrB_2 shows rather low oxidation resistance in air up from around 1100 °C, which can be improved by the addition of silicon containing secondary phases.

In the last few years research focused on using silicon-based polymer-derived ceramics (PDCs) as Si additive to further improve the high temperature properties of ZrB_2. However, the influence of PDCs on the oxidation behavior of ZrB_2-based ceramics is often neglected, especially during long-term exposure of more than 10 h.

In this study, ZrB_2 powder was coated with polymer-derived SiCN, SiZrCN or SiZrBCN, respectively, and hot-pressed, producing dense ceramic monoliths. The oxidation behavior was investigated at 1300 °C in synthetic air for 50 h and 100 h. An extensive study of the formed oxides and oxidation kinetics was carried out using thermogravimetric analysis (TGA), electron probe micro analysis (EPMA), and X-ray diffraction (XRD). The experimental findings were supported by thermodynamic equilibrium calculations using the CALPHAD method. From the calculations the formation of the gaseous species namely CO, B_2O_3, and SiO is derived, explaining the observed paralinear oxidation kinetics and formation of bubbles within the oxide scale. The results show an improved oxidation resistance for all three investigated materials in comparison to ZrB_2-SiC with ZrB_2-SiCN showing the highest oxidation resistance.