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Challenges in Production of Ultra-high Temperature Ceramics for Aerospace

Advanced ceramics possess admirable properties, such as high operating temperatures and low thermal conductivity, that make them well-suited for extreme environments, including those in the aerospace and nuclear industries. One of the most significant drawbacks of ceramics is the challenge of processing, particularly in the production of ultra-high-temperature ceramics (UHTCs), which must be sintered at temperatures above 2000℃, even with the addition of sintering additives. Densification of these materials causes many problems, such as warpage, shrinkage cracks, and gas porosity, all of which are detrimental to the final properties of the part.

This research drove the development of a new gel-casting method for ZrB2 to reduce the toxicity of the traditional process. Parameters such as solids loading, viscosity, and drying stages were optimised to produce defect-free complex parts for the aerospace sector. The preceramic polymer material was sintered in an inert atmosphere at 2000 ℃ for 2 hours, increasing the bulk density to 98% for ZrB2-SiC UHTC parts, after addressing multiple macro and microstructural challenges. This included an investigation into the effect of microstructure on the sintering ramp rate between 10℃/min and 3℃/min. Following this, the material was investigated using microscopy to assess phase dispersion and grain size.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

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Invitation letter for visa

No

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