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Impact of Silica loss on the microstructure, mechanical performance, and CMAS resistance of a Suspension Plasma Sprayed YbDS coating

Abstract:

The quantification of silica loss in Suspension Plasma Spray (SPS) YbDS allows for its control in future attempts to achieve coatings with specific phase composition, microstructures, and properties. This study utilized YbDS feedstock with D50 $\sim 1\ \mu\text{m}$ particle size to produce coatings with less cracks than existing feedstock. A pure YbDS feedstock contains 76.6 wt.% $[\text{Yb}]_2\text{O}_3$ and 23.4 wt.% SiO_2 , but the YbDS feedstock in this paper contains 70.3 wt.% $[\text{Yb}]_2\text{O}_3$ and 29.3 wt.% SiO_2 (which translates to $\sim 36\%$ extra silica) to compensate for high levels of silica loss that fine particles would experience, which was critical in the production of samples with a wide range of microstructures and composition. Variation of hydrogen gas parameter between 0% to 10% of 250 SLM was used as a means of controlling silica loss. 6 SPS free standing coatings of different YbDS-YbMS ratios and microstructures were produced and underwent crystallisation heat treatment at $1300\ ^\circ\text{C}$ for 10 h before analysis. The impact of silica loss on phase composition and microstructure was analysed, followed by analysis of how this affects the mechanical properties of the samples, and lastly their contribution to the sample's resistance to CMAS attack after 4 h and 8 h tests.