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Solution Precursor Plasma Spraying as a One-step Route for Depositing Refractory High-Entropy Oxide Coatings

Abstract:

High-entropy oxides (HEOs) are being explored as a new class of materials for high-temperature applications, including thermal barrier coatings. However, processing HEOs as coatings remains challenging. Conventional powder-based thermal spray routes first require the synthesis of chemically homogeneous multicomponent powders, followed by deposition under conditions that may further influence the final coating chemistry and phase constitution. Solution precursor plasma spraying (SPPS) offers a promising alternative, where the required cations are introduced in solution form and converted in situ into HEOs to directly form coatings.

In this work, SPPS was used to deposit HEO coatings based on rare-earth zirconate chemistries. The initial spray trials focused on precursor formulation, coating build-up, chemistry retention, and desired phase formation. The results show that adherent HEO coatings can be produced, with evidence of in situ formation of complex oxide phases. The coating chemistry was also found to depend strongly on precursor composition and spray conditions.

Overall, the results demonstrate the potential of SPPS for direct one-step deposition of HEO coatings. The results provide a strong basis for further refining the SPPS route, with the aim of achieving repeatable refractory HEO coatings with controlled chemistry, phase constitution, and microstructure.