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Machine Learning Derived High Temperature Ceramic Coating on C/C Composite

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ABSTRACT

Under high temperature extreme service conditions, high temperature ceramic coatings have become a key technical approach to ensure the stable application of thermal structural materials such as carbon/carbon (C/C) composites and ceramic matrix composites. High temperature ceramic coatings are high-performance thermal protection coatings mainly composed of ultra-high temperature ceramics (UHTCs) including carbides, borides and nitrides with melting points exceeding 3000 °C, modified by silicides, oxides or silicates. In an oxidative ablation atmosphere, the thermal structural stability and continuity of high-melting-point UHTCs and their oxides determine the ultra-high temperature service performance of the coatings. Focusing on UHTC coatings for C/C composites, this report systematically establishes a high temperature ceramic coating database, and adopts artificial intelligence algorithms to train and verify intelligent ceramic coating models applicable to ultra-high temperature oxidative ablation environments. With an active learning strategy, the long-term ultra-high temperature oxidation and ablation resistance of the ceramic coating systems were experimentally validated. This study provides theoretical and technical references for breaking the barriers of blind design by the traditional trial-and-error method, and promoting the intelligent design and performance verification of high temperature ceramic coatings.

KEYWORDS

Machine Learning; ceramic coating; high temperature; C/C composite

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