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SiC nanowires/ribbons reinforced high-temperature ceramic coatings

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Carbon/carbon (C/C) composites are prone to oxidize and ablate at elevated temperatures, which limits their applications as high-temperature structural materials. The ceramic coatings are considered to be the effective methods to solve this problem. However, the intrinsic brittleness of these coatings and the mismatch of the poor interfacial bonding between these coatings and C/C substrate often give rise to the cracking of the coatings, which results in the failure of the coatings. To solve these problems, in our work, the ceramic coatings reinforced by the well-dispersion SiC nanowires/ribbons with different morphology and aspect ratios were proposed and prepared by chemical vapor deposition, in-situ synthesis and pack cementation. The as-prepared coatings possessed the excellent oxidation protective ability, which achieved the oxidation protective of silicon-based ceramic coatings for C/C composites between 1500 °C and room temperature. Our study not only revealed the traditional toughening mechanisms of SiC nanowires/ribbons including nanowire/ribbon pull-out, nanowires/ribbon bridging, crack deflection and microcrack toughneing, but also revealed the novel toughening mechanisms of SiC nanowires including the plasticity deformation of the nanowires, the plasticity fracture at the interface of the nanowire-matrix, and the generated special mechanical interlocking. In addition, our study also discovered that the interfacial bonding strength of carbon and ceramic materials with other materials was improved significantly by in-situ synthesizing SiC nanowires/ribbons on their surface, and revealed the novel interface anchoring mechanisms of SiC nanowires/ribbons involving the interfacial bonding anchoring and the mechanical interlocking anchoring.

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