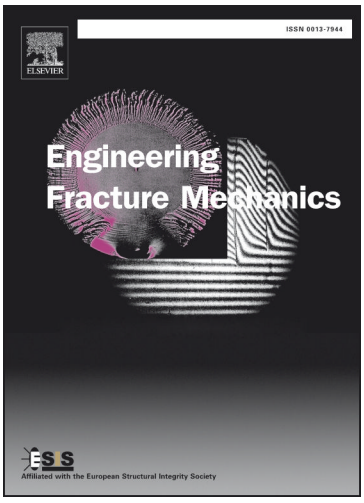

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Interfacial fracture behavior of double-ceramic-layer thermal barrier coating system with segmented structure

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Abstract

Segmented double-ceramic-layer thermal barrier coating system (DCL-TBCs) is promising for application in next-generation turbines. Such segmented coatings contain a large number of vertical cracks within the ceramic top coats for enhancing the coating strain tolerance. However, when the coatings are subjected to thermal loading, delaminations may arise from the roots of the vertical cracks to induce the coatings spallation. In this work, we numerically studied the delamination behavior of the segmented DCL-TBCs. The contact between interface crack faces was taken into account in the computational model. The effects of segmentation pattern, geometrical and material properties of the top coats on the delamination behavior were discussed. It was found that the predefined vertical cracks are beneficial in reducing the delamination driving forces at interface crack tips. The vertical crack density is a critical factor that affects the delamination behavior. In case of low vertical crack density, the delamination driving forces are significantly increased as the elastic modulus and thickness of the outer top coat increase. However, the driving forces become insensitive to the top coat properties when the vertical crack density is sufficiently high. Moreover, a design map was constructed for guiding the selections of preferable properties for the segmented DCL-TBCs.

Keywords: Thermal barrier coatings; Double ceramic layer; Segmented structure; Interfacial fracture; Dense vertical crack

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