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PROCEEDINGS

Interfacial Delamination in High-Temperature Coatings with Segmented Microstructures

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ABSTRACT

High-temperature coatings are extensively used in aircraft engines and industrial gas turbines to protect hot-section components from harsh operating environments [1]. Representative high-temperature coatings include thermal barrier coatings and environmental barrier coatings, which are applied to substrates made of superalloy and ceramic matrix composites, respectively. The durability of the coatings is of significant importance for the structural integrity of the components [2-4]. A segmented microstructure was widely used to improve the coatings' durability. A network of through-thickness vertical cracks is introduced into the outer layer of the coatings, which increases the compliance of the coatings and therefore reduces the interfacial stress. Nonetheless, the segmented coatings are still susceptible to interfacial delamination when subjected to thermal fatigue or excessive loading conditions. To postpone the growth of the interface cracks, it is important to elucidate their cracking behavior and clarify various influential factors. In recent years, we have conducted numerical studies on the interfacial delamination problems in the high-temperature coatings with segmented microstructures. This presentation will summarize the delamination behavior in the segmented coatings. Several topics will be involved, including the formation mechanisms of the failure modes, the effects of non-uniformity of the microstructures, and the delamination behavior in multi-layered coatings. The idea of design map will be introduced to further improve the durability of the coatings.

KEYWORDS

Interfacial delamination; segmented microstructure; high-temperature coatings; numerical analysis

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References

1. Li, B., Shu, Y., Li, Y. (2022). Interface cracking behavior in high-temperature coatings with non-uniformly distributed segmentation cracks. *European Journal of Mechanics-A/Solids*, *96*, 104674.
2. Li, B., Fan, X., Okada, H., Wang, T. (2018). Mechanisms governing the failure modes of dense vertically cracked thermal barrier coatings. *Engineering Fracture Mechanics*, *189*, 451-480.
3. Li, B., Fan, X., Zhou, K., Wang, T. (2018). A semi-analytical model for predicting stress evolution in multilayer coating systems during thermal cycling. *International Journal of Mechanical Sciences*, *135*, 31-42.
4. Li, B., Fan, X., Wang, T., Zhou, K. (2018). Interfacial fracture behavior of double-ceramic-layer thermal barrier

coating system with segmented structure. *Engineering Fracture Mechanics*, *201*, 13-28.