Influence of Microstructure on Multiple Surface Cracking Behavior of Film/Substrate Structure

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The multifunctional demands and desire of thermal barrier coatings (TBCs) to operate at higher temperature are driving new TBCs innovations based on modification of its different components. One potential strategy for improving coatings durability is to deliberately engineer cracks and porosity into the top-coat to make it highly compliant and "strain tolerant". In this paper, the influence of microstructure on the surface cracking behavior of film/substrate structure is investigated using the S-FEM method. Pores with different orientations, shapes, and sizes are modeled and its effects on the vertical cracks are analyzed based on the virtual crack closure method. Numerical results indicate that the pores not only affect the crack driving force of surface cracks, but also affect the crack path significantly. Since the morphology of pores characterizes the idealized and simplified structure of air plasma spraying (APS) deposited top coats, the results provides some guide lines for the microstructure modification of APS-TBCs.

Keywords: Film/Substrate, Surface Crack, Microstructure, S version-FEM, Crack Driving force