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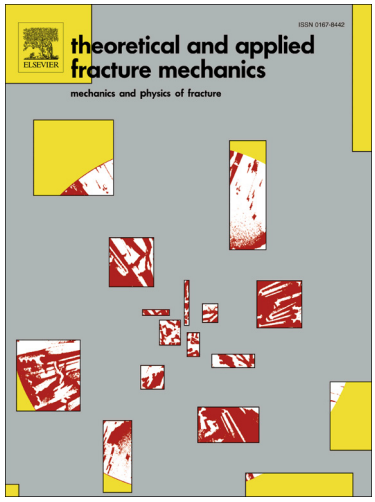

Effects of substrate thickness and heat transfer scheme on edge cracking of a brittle coating due to thermal transients

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Effects of substrate thickness and heat transfer scheme on edge cracking of a brittle coating due to thermal transients

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Abstract Brittle coatings may suffer edge cracking due to thermal transients. The thermal stress intensity factor (TSIF) is used here to characterize the driving force for such damage modes. The purpose of this paper is to investigate the effect of substrate thickness and heat transfer scheme on the edge cracking behavior. The transient temperature and thermal stress field of the un-cracked system are first obtained in closed forms. The weight functions suitable for thermal loading are then developed for the edge-cracked coating. The TSIF at the crack tip is finally obtained based on the principle of superposition, with the equal thermal stresses utilized as the crack surface tractions. The dependence of the normalized TSIF is examined on different thermal boundary condition, normalized time, and relative crack depth as well as substrate/coating thickness ratio. It is found the thicker substrate leads to much higher driving force for the edge cracking. The heat transfer schemes on the lower surface of the substrate, however, have insignificant effect on it. The findings of this study may assist in the integrity analysis of coatings due to rapidly changing thermal environments.

Keywords: Coating; Edge cracking; Weight function; Thermal stress intensity factor (TSIF)

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