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PROCEEDINGS

Characterization on Fracture Toughness of Cermet Coating Coupling Instrumented Indentation and X-Ray Computed Tomography

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ABSTRACT

The surface brittle fracture of cermet coating seriously restricts its application. Accurate evaluation of the fracture toughness of cermet coating is a prerequisite for improving its life. This paper aims to propose an accurate characterization method for fracture toughness of cermet coating. By coupling instrumented indentation and X- ray computed tomography, the indentation-induced fracture behaviors under various loads within WC-12%Co coatings were studied. The indentation response was correlated with the damage evolution directly observed within the coating. The impact of substrate effects on indentation-induced fracture behaviors was further studied using finite element analysis (FEA). The three-dimensional subsurface crack morphologies under different loads were nondestructively observed. The first pop-in event in the load-displacement (P-h) curve was determined to be triggered by bottom cracking, marking the onset of the multiple fracture mode. With the absence of pop-in events in the indentation response, Laugier's equation offered a consistently stable and reliable estimation of fracture toughness for the coating. The critical indentation depth for the first pop-in was suggested as the threshold for reliably extracting intrinsic fracture toughness of coatings. Numerical results revealed a constant linear relationship between the critical depth and coating thickness, and a high sensitivity of the critical depth to yield stress of the substrate.

KEYWORDS

Instrumented indentation; cermet coating; pop-in, fracture toughness; X-ray computed tomography

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