

Asymptotic Analysis of a Stationary Crack in a Ductile Functionally Graded Material

Dhirendra V. Kubair⁽¹⁾, Philippe H. Geubelle⁽²⁾, John Lambros⁽²⁾

(1) *Department of Aerospace Engineering, Indian Institute of Science, Bangalore, India*

(2) *Department of Aerospace Engineering, University of Illinois at Urbana-Champaign, USA*

The dominant and higher-order asymptotic stress and displacement fields surrounding a stationary crack embedded in a ductile functionally graded material subjected to anti-plane shear loading are derived. It is shown that the leading (most singular) term in the asymptotic expansion is the same in the graded material as in the homogeneous one with the properties evaluated at the crack tip location. Assuming a power law for the plastic strains and another power law for the material spatial gradient, we derive the next term in the asymptotic expansion for the near-tip fields. The second term in the series may or may not differ from that of the homogeneous case depending on the particular material property variation. This result is a consequence of the interaction between the plasticity effects associated with a loading dependent length scale (the plastic zone size) and the inhomogeneity effects, which are also characterized by a separate length scale (the property gradient variation).

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