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Adiabatic Shear Bands in Functionally Graded Materials

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The initiation and propagation of adiabatic shear bands (ASBs) in functionally graded materials (FGMs) with continuously varying material properties and deformed in plane strain tension are studied. An ASB is a narrow region, a few microns wide, of intense plastic deformation that forms after softening of the material due to heating and damage evolution has overcome its hardening due to strain- and strain-rate effects. Each constituent and the composite are modeled as isotropic microporous strain- and strain-rate hardening and thermally softening materials with effective properties of the composite derived by the rule of mixtures. Gurson's flow potential, a hyperbolic heat equation, and degradation of material properties with porosity are employed. It is found that ASBs, always aligned along the direction of the maximum shear stress, form sooner in an FGM than in either of the two constituent materials with their location, orientation, pattern and speed depending upon the compositional profile.

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