COHESIVE FRACTURE MODELING OF ELASTIC-PLASTIC CRACK GROWTH IN FUNCTIONALLY GRADED MATERIALS

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This work investigates elastoplastic crack growth in ceramic/metal functionally graded materials (FGMs). The study employs a phenomenological, cohesive zone model with six material dependent parameters (the cohesive energy densities and the peak cohesive tractions of the ceramic and metal phases, respectively, and two cohesive gradation parameters). A volume-fraction based, elastic-plastic model describes the response of the bulk background material. The numerical analyses are performed using WARP3D, a fracture mechanics research finite element code, which incorporates solid elements with graded elastic and plastic properties and interface-cohesive elements coupled with the functionally graded cohesive zone model. Numerical values of volume fractions for the constituents specified at nodes of the finite element model set the spatial gradation of material properties with isoparametric interpolations inside interface elements and background solid elements to define pointwise material property values. The presentation describes applications of the cohesive zone model and the computational scheme to analyze crack growth in a single-edge notch bend, SE(B), fracture specimen made of a TiB/Ti FGM. The investigation also shows significant crack tunneling in the Ti metal SE(B) specimen. For the TiB/Ti FGM, however, crack tunneling is pronounced only for a metal-rich specimen with relatively smaller cohesive gradation parameter for the metal.

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