

Microstructural Modeling of Dynamic Fracture Modes in Crystalline Alloys

Qifeng Wu¹, Mohammed A. Zikry²

¹ North Carolina State University, Department of Mechanical and Aerospace Engineering, Raleigh, NC, USA, qwu@ncsu.edu

² North Carolina State University, Department of Mechanical and Aerospace Engineering, Raleigh, NC, USA, zikry@ncsu.edu

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A dislocation-density based crystalline plasticity model for dislocation transmission and pile-ups at grain boundaries and a microstructural failure criterion accounting for significantly improved ductility and fracture toughness in crystalline materials. Specialized finite-element methodologies using overlapping elements to represent evolving fracture surfaces are then used for a detailed analysis of fracture nucleation and intergranular and transgranular crack nucleation and growth. Criteria are developed for dislocation-density interactions and immobilization, and are directly related to crack blunting and deflection for applications related to martensitic steels, layered crystalline materials, and energetic materials..