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An extended finite element formulation for modeling the response of polycrystalline materials to shock loading JOSHUA ROBBINS, THOMAS VOTH, Sandia National Laboratories — The eXtended Finite Element Method (X-FEM) is a finite element based discretization technique developed originally to model dynamic crack propagation [1]. Since that time the method has been used for modeling physics ranging from static mesoscale material failure to dendrite growth. Here we adapt the recent advances of Benson et al. [2] and Belytchko et al. [3] to model shock loading of polycrystalline material. Through several demonstration problems we evaluate the method for modeling the shock response of polycrystalline materials at the mesoscale. Specifically, we use the X-FEM to model grain boundaries. This approach allows us to i) eliminate ad-hoc mixture rules for multi-material elements and ii) avoid explicitly meshing grain boundaries. ([1] N. Moes, J. Dolbow, J and T. Belytschko, 1999,"A finite element method for crack growth without remeshing," International Journal for Numerical Methods in Engineering, 46, 131-150. [2] E. Vitali, and D. J. Benson, 2006, "An extended finite element formulation for contact in multi-material arbitrary Lagrangian-Eulerian calculations," International Journal for Numerical Methods in Engineering, 67, 1420-1444. [3] J-H Song, P. M. A. Areias and T. Belytschko, 2006, "A method for dynamic crack and shear band propagation with phantom nodes," International Journal for Numerical Methods in Engineering, 67, 868-893.)

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