

FINITE DEFORMATION OF SHEAR CRACKS: CONTINUUM ANALYSIS INCORPORATING THE HARMONIC INTERATOMIC POTENTIAL

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Recent molecular dynamics simulations of dynamic crack propagation have shown that there is a finite crack opening for a purely mode II crack. This observation is at odds with classical linear elastic solutions which indicates that a purely mode II crack should have zero opening. To understand this discrepancy, we develop in this paper a finite deformation continuum theory incorporating an interatomic potential function to describe the near tip deformation of a crack in an isotropic crystal with triangular lattice microstructure. Using an asymptotic method developed by Knowles (1981), we show that there is indeed a finite crack opening for a purely mode II crack, which can be attributed to the geometric nonlinearity of finite deformation near the crack tip. The mode II crack opening is found to be on the order of lattice constant, which is in agreement with atomistic studies.

References

J. K. Knowles, "A Nonlinear Effect in Mode II Crack Problems," *Engineering Fracture Mechanics*, v. 15, p. 469-476, 1981.