MAR12-2011-002816

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Shapes formed by interacting cracks

KAREN DANIELS, Dept. of Physics, North Carolina State University

Brittle failure through multiple cracks occurs in a wide variety of contexts, from microscopic failures in dental enamel and cleaved silicon to geological faults and planetary ice crusts. In each of these situations, with complicated stress geometries and different microscopic mechanisms, pairwise interactions between approaching cracks nonetheless produce characteristically curved fracture paths. We investigate the origins of this widely observed "en passant" crack pattern by fracturing a rectangular slab which is notched on each long side and subjected to quasi-static uniaxial strain from the short side. The two cracks propagate along approximately straight paths until they pass each other, after which they curve and release a lens-shaped fragment. We find that, for materials with diverse mechanical properties, each curve has an approximately square-root shape, and that the length of each fragment is twice its width. We are able to explain the origins of this universal shape with a simple geometrical model.