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A finite Zener-Stroh crack interacting with a blunt crack under in-plane deformations. (English)

Summary: A Zener-Stroh crack is the name given to a microcrack resulting from the coalescence of edge dislocations along a slip plane. The process by which the crack is initiated was proposed in the first instance by Zener and later examined in detail by Stroh. The Zener-Stroh crack can be thought of as being equivalent, in some sense, to the Griffith crack in classical linear elastic fracture mechanics. We study a finite mode I and II Zener-Stroh crack interacting with a nearby mode I and II blunt crack represented by a parabolic cavity. In this respect, the Zener-Stroh crack can be considered as a coalescence of edge dislocations emitted from the blunt crack. A conformal mapping function is introduced which maps the parabolic boundary onto a straight line in the image plane. By treating the Zener-Stroh crack as a pileup of edge dislocations, two Cauchy singular integral equations are constructed in the image plane. The Gauss-Chebyshev integration formula is applied to numerically solve the resulting singular integral equations. The local mode I and II stress intensity factors at the two tips of the Zener-Stroh crack are determined. We establish conditions on the propagation direction of the Zener-Stroh crack away from or toward the blunt crack. Also established are the conditions for the emission of an edge dislocation from the blunt crack by treating the edge dislocation as a Zener-Stroh crack with infinitesimal length. The dislocation emission criteria from the blunt crack are established here in elementary closed form and will thus be particularly convenient for application in engineering practice.

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