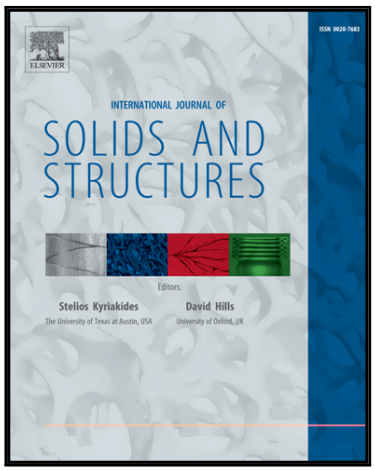

Interaction of cracks with dislocations in couple-stress elasticity. Part II: Shear modes

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Interaction of cracks with dislocations in couple-stress elasticity. Part II: Shear modes

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Abstract: In the second part of this study, the interaction of a finite-length crack with a glide and a screw dislocation is examined within the framework of couple-stress elasticity. The loading from the two defects on the crack results to plane and antiplane shear modes of fracture, respectively. Both problems are attacked using the distributed dislocation technique and the cracks are modeled using distributions of discrete glide or screw dislocations. The antiplane strain case is governed by a single hyper-singular integral equation with a cubic singularity, whereas the plane strain case by a singular integral equation. In both cases, the integral equations are numerically solved using appropriate collocation techniques. The results obtained herein show that a crack under antiplane conditions closes in a smoother way as compared to the classical elasticity result. Further, the evaluation of the energy release rate in the crack tips reveals an 'alternating' behavior between strengthening and weakening effects in the plane strain case, depending on the defect's distance from the crack tip and the magnitude of the characteristic material length. On the other hand, the energy release rate in the antiplane mode shows a strengthening effect when couple-stresses are considered.

Keywords: Screw Dislocation; Glide Dislocation; Microstructure; Hyper-singular Integral Equations; couple-stress theory.

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