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Analytical Study of Crack-Tip Plasticity SERGIO PICOZZI, ROBIN SELINGER, Catholic University of America — The mechanical response of a crack in a ductile solid depends on both the temperature and the stress state of the crack tip. At finite temperature, a crack under a subcritical applied load may emit dislocations via thermal activation, a process associated with creep. However it is not clear how to estimate the relevant activation energy or its dependence on the stress state of the crack tip. To address these issues, we consider a classical problem in elastostatics: the interaction of a screw dislocation with a finite crack under a shear load in an isotropic elastic solid. In the simplest geometry, this boundary value problem can be framed in two dimensions. Using conformal mapping techniques, we analytically solve for the displacement field, which in turn yields the relevant component of the stress field and, finally, the energy of the dislocation as a function of distance from the crack tip. This technique provides a means to explore the nature of the energy barrier and its variation with applied load in the continuum limit. We compare these findings with results from computer simulation studies of thermally activated ductile yield at finite temperature.

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