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Weight Functions for Cracks in Piezoelectrics

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The weight function in fracture mechanics relates the stress intensity factor at the tip of a crack in an elastic body to a point load at an arbitrary location. For a piezoelectric material, this definition is extended to include the effect of point charges and the presence of an electric displacement intensity factor at the crack tip. The weight functions for the different crack opening Modes are derived from any known mixed-mode solution in terms of displacements and electric potentials of the cracked body under specific electromechanical loads. A second type of piezoelectric crack weight function is derived from a mixed-mode solution in terms of stresses and electric charge densities yielding field intensity factors due to mechanical displacements and electric potentials. Furthermore, the piezoelectric weight function is applied to calculate displacement and electric potential fields in a cracked body under arbitrary electromechanical loads. More applications include the investigation of effects like bridging or small scale switching on the field intensiy factors.

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