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Path Independent Integrals in Equilibrium Electro-Chemo-Elasticity

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Abstract

By using the Noether's first theorem, this paper constructed two types of path-independent integrals in equilibrium electro-chemo-elasticity and proved their uniqueness. These path-independent integrals are the electro-chemo-elastic extensions of the classical J - and L -integrals in elasticity. Similar to their elastic counterparts, the electro-chemo-elastic J - and L -integrals represent energy release when a crack or a cavity undergoes a translation and rotation, respectively. Also shown in this paper is that the M -integral in elasticity cannot be extended to electro-chemo-elasticity. Results of this study established a theoretical foundation for energy conservation laws in equilibrium electro-chemo-elasticity. Such conservation laws are useful in modeling various phenomena in electro-chemo-elastic systems. In addition, the path-independent integrals obtained here provide a theoretical tool for understanding and a practical tool for numerical evaluation of singular fields.

Keywords: Path-independent integral, conservation laws, electro-chemo-mechanics, multi-field interaction.

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