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Plane problems of magneto-electro-elastic fibrous composites

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The magneto-electric coupling refers to the polarization induced by a magnetic field, or conversely the magnetization induced by an electric field. This ME effect has recently drawn ever-increasing interest due to their potential applications as multifunctional devices ranging from ME data storage and switching and large-area sensitive detection of magnetic fields to energy harvesting. However, the coupling is rather weak in a single-phase material and is often observed at low temperature, and this has motivated the study of composites of piezoelectric and piezomagnetic media.

This work studies the magneto-electro-elastic potentials and field distributions in a fibrous composite with piezoelectric and piezomagnetic phases subjected to plane strain with transverse electromagnetic fields. The matrix is infinite containing arbitrarily distributed circular inclusions, which may have different sizes and material properties. We show that this coupling problem can be reduced to an equivalent plane elasticity problem through an eigenstrain corresponding to the electro-magneto-elastic effect [1]. We generalize the classic of Muskelushvili [2] to obtain the elastic potential of the composite to the current multi-field multi-inclusion problem. Numerical results are presented for selected systems with sufficient accuracy.

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