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Theoretical analysis of material constants in thermopiezoelasticity

Materials with thermopiezoelastic properties have both theoretical and practical significance in solid-state physics and materials science. Thermopiezoelastic media exhibit coupling among the thermal, electric and elastic fields. Strain, electric displacement and entropy can be written in terms of stress, electric field and temperature. Investigation is concerned with the analysis of nonlinear thermopiezoelasticity using thermodynamic principles. Strain, electric displacement and entropy are expanded into Taylor series. Zeroth to eighth rank tensors are derived for describing material constants. Relationship of material constants of strain, electric displacement and entropy are obtained in thermopiezoelasticity. Due to intrinsic coupling behavior, thermopiezoelastic materials are widely used as sensors and actuators in sensing, actuation, and control of smart structures. Mathematical expressions of material constants may be useful for future investigation of the mechanics and physics of nonlinear thermopiezoelasticity.

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