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A New Nonlinear Constitutive Relation for Magnetostrictive Materials

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To overcome some deficiencies in previous constitutive relations of magnetostrictive materials, a new constitutive relation for a Terfenol-D rod is proposed in this paper to describe the non-linear and coupling constitutive features of the rod based on its magnetoelastic coupling mechanism. In comparison with the previous constitutive relations, the new constitutive equations can effectively not only predict the magnetostrictive strain values of Terfenol-D rods under various compressive pre-stresses in various region of the magnetic fields, but also describe the effect of the pre-stress on the maximum magnetostrictive strain and the magnetization of a Terfenol-D rod as well as the effect of the pre-stress and the magnetization on the Young's modulus. Moreover, it is convenience for the new relation to be used in engineering application since the constitutive constants adopted in the new model are easily measured in experiments.

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