MAGNETO-ELASTIC MODELING OF COMPOSITES WITH CHAIN-STRUCTURED MAGNETOSTRICTIVE PARTICLES

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Magneto-elastic behavior is investigated for two-phase composites containing chain-structured magnetostrictive particles under both magnetic and mechanical loading [1, 2]. To derive the local magnetic and elastic fields, three modified Green's functions are derived and explicitly integrated for the infinite domain containing a spherical inclusion with a prescribed magnetization, body force, and eigenstrain. A representative volume element containing a chain of infinite particles is introduced to solve averaged magnetic and elastic fields in the particles and the matrix. Effective magnetostriction of composites is derived by considering the particle's magnetostriction and the magnetic interaction force. It is showed that there exists an optimal choice of the Young's modulus of the matrix and the volume fraction of the particles to achieve the maximum effective magnetostriction. A transversely isotropic effective elasticity is derived at the infinitesimal deformation. Disregarding the interaction term, this model provides the same effective elasticity as Mori-Tanaka's model. Comparisons of model results with the experimental data and other models show the efficacy of the model and suggest that the particle interactions have a considerable effect on the effective magneto-elastic properties of composites even for a low particle volume fraction.

References

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