Composite dielectric elastomers modeling based on statistical mechanics

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Abstract	We propose in this work a hybrid microstructural-phenomenological modeling of composite dielectric elastomer based on statistical mechanics. The composite dielectric elastomer is made from high permittivity filler particles doped to elastomeric based material. We assume that the particles are uniformly distributed in the based material and form particle-chain structures. With the help of statistical mechanics, the electroelastic strain energy is formulated from the particle-chain reorientation induced by applied electric field. Moreover, the phenomenological dielectric constant model is used to eliminate the inverse Langevin function in the strain energy formulation. Our proposed constitutive model is validated with respect to two electroelastic experiments which use two composite dielectric elastomers with different material properties. From the validation, our proposed model works well to capture large stretch electroelastic deformations not only for different material properties but also for different particle fraction in the composite dielectric elastomer.
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