Electroelasticity of dielectric elastomers based on molecular chain statistics

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Abstract	Mechanical response of dielectric elastomers can be influenced or even controlled by an imposed electric filed. It can, for example, cause mechanical stress or strain without any applied load. The latter phenomenon is referred to as electrostriction. There are many phenomenological hyperelastic models describing this electro-active response of dielectric elastomers. There, coupled electro-elastic terms are of special importance. So far, these terms have not got any physical reasoning. In this contribution, we proposed an electro-mechanical constitutive model based on molecular chain statistics. The model considers polarization of single polymer chain segments and takes into account their directional distribution. The latter one results from the non-Gaussian chain statistics taking finite extensibility of polymer chains into account. The so resulting electric potential of a single polymer chain is further generalized to the network potential serving as a basis for the prediction of the above mentioned electro-active response. The model includes a few number of physically interpretable material constants and demonstrates good agreement with experimental data.
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