The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

On thermo-electro-viscoelasticity of dielectric elastomers: A comprehensive experimental study meets numerical modelling

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Keywords: *Dielectric Elastomers, Electro-Active Polymers, Thermo-mechanical Coupling, Viscoelasticity*

Dielectric elastomers are a class of solid polymeric materials that are sufficiently soft to deform under the application of an electric field due to the interaction of quasi-static electric charges. Their potential to undergo large deformations renders them promising candidates for the design of energy harvesters, sensors and soft actuators [1]. For their applications however, the influence of additional thermal effects should be taken into account as the base materials frequently show a distinct thermal sensitivity that drastically influences their mechanical responses. This contribution presents the results of a wide range of experiments conducted on the popular dielectric elastomer VHB 4905™ under a combination of mechanical, thermal and electric loading scenarios [2]. Constitutive modeling and numerical simulation of electro-active polymers are active fields of current research. However, on the one hand, their experimental study under complex loading conditions is non-trivial. On the other hand, very few constitutive modeling approaches meet with experimental data obtained from thermo-electro-mechanical loading conditions. In this contribution, we aim to develop a thermo-electro-mechanically coupled model, which will closely replicate the response of an electro-active polymer investigated under a combination of thermal, electric and mechanical loads. Once the model is calibrated with the experimental data and then it is validated with a different set of data, which shows excellent agreement with experimental findings [3].

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