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Simulation of Magneto-Dielectric Effect in Magneto-Rheological Elastomers

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We present the results of numerical simulation of magnetodielectric effect (MDE) in magnetorheological elastomers (MRE) – the change of capacity of plane capacitor filled with magnetic elastomer and placed under the external magnetic field. The computer model of effect is based on the assumption about the displacement of magnetic particles inside the elastic matrix under the external magnetic field and the formation of chain-like structures. Such displacement of metallic particles between the planes of capacitor leads to the change of capacity, which can be considered as a change of effective dielectric permittivity of elastomer caused by magnetic field (magnetodielectric effect).

The developed model resulted in perfect qualitative agreement with all experimental data obtained earlier for Fe-based elastomers. The proposed model is useful to study these novel functional materials, analyze the features of magnetodielectric effect and predict the optimal composition of magnetorheological elastomers for further profound experimental study.

In this work we simulated MDE for series of samples varying with concentration of magnetic filler, size and space distribution of particles, elastic properties of matrix. We have found that the effect tends to saturation and has hysteretic feature due to the elastic response of matrix. The influence of orientation of magnetic field and capacitor plane was studied as well, the change of sign of the effect for parallel and perpendicular orientation was observed as well.

Biography:

Nikolai Perov works in Lomonosov MSU since 1977, PhD in magnetism - 1986, DrSc in magnetism - 2009, visiting experience - Tohoku university, Toyohashi university of technology, National University of Singapore, Duisburg-Essen university. Nowadays he is the head of the magnetism department of Lomonosov MSU. Research interests are in investigation of magnetic field.