

Mechanical Response of Soft Magnetoactive Elastomers to Magnetic Fields

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Magnetoactive elastomers (MAEs) are promising materials for various applications requiring controlled changes in mechanical properties under the influence of a magnetic field. Understanding the magnetomechanical behavior of MAEs is necessary to optimize their characteristics, particularly their shear modulus (see, for example, Kostrov et al. [1]). The aim of this work is to develop a microscopic model to describe the elastic properties of soft MAEs, taking into account the formation of chains of magnetic particles under the influence of an external magnetic field (an illustration of the model is presented in Figure 1). A theoretical model based on a lattice approach and a hierarchical principle of particle aggregation into chains has been developed. Isotropic and anisotropic MAEs are considered. An analysis of the dependence of the shear modulus on the magnetic field and shear deformation was carried out. Analytical expressions for the shear modulus of MAEs depending on the material parameters and external influences were obtained. It is shown that anisotropic MAEs have higher elastic characteristics compared to isotropic ones.

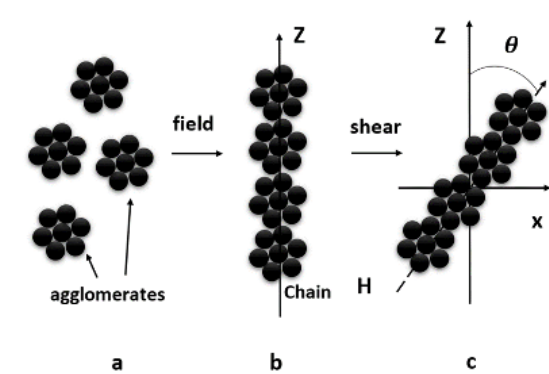


Figure 1: An illustration of the simulated system.

The theoretical results are in good agreement with experimental data, which confirms the adequacy of the proposed model. The developed model allows us to adequately describe the magnetomechanical behavior of soft MAEs. The formation of chains of magnetic particles plays a key role in determining the elastic properties of MAEs. Anisotropic MAEs are of greater interest for practical applications due to their improved mechanical characteristics.

Acknowledgments

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References

[1] Kostrov S.A., Gorodov V.V., Muzafarov A.M., Kramarenko E.Yu. // *Vysokomolekulyarnye soedineniya. Seriya B, izdatelstvo FGBU "Izdatelstvo "Nauka" (Moskva), tom 62, № 6. 2022.*

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