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Mathematical modeling and Monte Carlo study on elongation of liquid crystal elatomer under external electric fields

Liquid crystal molecules (LC) are combined with polymers and form a meta-material, the so-called liquid crystal elastomer (LCE). LCE elongates into a direction along which the LC molecules align due to the activation forces such as external electric fields. The temperature change also makes LCE oblong and anisotropic. This LCE elongation has been studied for its engineering application to sensors or actuators such as artificial muscle.

The reason for the elongation is qualitatively well understood. However, the microscopic interaction between LC molecules and polymers for the qualitative understanding of the LCE elongation is still unclear. Recently, we applied Finsler geometry (FG) modeling technique for the soft elasticity and elongation of LCE, and we obtained the consistent results with the reported experimental data [1]. This FG technique introduces an interaction of LCE directional degree of freedom and the polymer position via the Finsler metric, and therefore the interaction is understood as a coarse grained one. For this reason, the FG technique should be checked in more detail in specific phenomena, though it has a potential advantage and can be applied to a lot of anisotropic phenomena [2].

In this talk, we apply the FG model technique to analyze LCE elongations caused by external electric fields. Monte Carlo (MC) results for the strain vs. electric filed will be compared with the reported experimental data.

[1] K.Osari and H.Koibuchi, Finsler geometry modeling and Monte Carlo study of 3D liquid crystal elastomer, Polymer 114, pp.355-369 (2017).

[2] Y.Takano and H.Koibuchi, J-shaped stress-strain diagram of collagen fibers: Frame tension of triangulated surfaces with fixed boundaries, Phys. Rev. E95, 042411 (2017).

Biography

Hiroshi Koibuchi completed his PhD from Tokyo Institute of Technology. He is a professor of National Institute of Technology, Ibaraki College. He has published more than 76 journal papers.

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