Continuum theories for liquid crystals and their applications

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Abstract

crystals are classical examples of partially ordered materials that combine fluidity with the directionality and ordering of solids. Liquid crystals are anisotropic materials, with direction-dependent physical, optical and rheological properties, making them the working material of choice for a range of opto-electronic devices, e.g., liquid crystal displays, photonics, sensors, photovoltaics etc. In this talk, we review the mathematical theories for three canonical liquid crystal phases: nematic liquid crystals, smectic liquid crystals and cholesteric liquid crystals. We focus on Landau-de Gennes type theories for these phases and describe the essential mathematical frameworks - the liquid crystal order parameters, the free energies, the governing systems of partial differential equations and their solution landscapes. We conclude with some case studies that illustrate the applications of these mathematical frameworks to prototype devices and real-life experiments. All collaborations will be acknowledged throughout the talk.

Keywords: liquid crystals, Landau-de Gennes theory, continuum mechanics, non-linear partial differential equations, variational methods etc.

References

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