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EDITORIAL

Editorial for Special Collection on Liquid Crystal Elastomers and Their Theory

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Soft responsive materials represent a contemporary, multidisciplinary area of research, which due to its many challenges and opportunities has become increasingly active around the world. Among them, liquid crystal elastomers (LCEs) have captured the imagination of physical scientists since they were first envisioned by P.G. de Gennes in 1975 and successfully synthesized by H. Finkelmann and collaborators in 1981. Thanks to their shape-shifting ability through large reversible deformations under ambient stimuli like temperature and light, they seem the stuff of science-fiction. Biodegradable, recyclable and reprocessable LCEs are also being achieved, rendering them suitable for many future applications in science, manufacturing, and medical research. However, despite the fact that their key constituents, namely polymeric chains and liquid crystal mesogens, are well understood and widely utilized in major industries like rubber tires and liquid crystal displays, the vast potential of LCEs remains largely untapped.

While experimental studies of LCEs have surged in recent years through the advent of additive manufacturing technologies (3D and 4D printing), a deeper understanding of these materials leading to breakthroughs in the industrial sector is paramount and necessitates advanced theoretical and computational tools. The current fundamental knowledge of LCEs was established by Mark Warner and co-workers at Cavendish Laboratory, Cambridge, by combining the theories of liquid crystals and rubber elasticity. This theoretical foundation is contained in the classical monograph by M. Warner & E.M. Terentjev (2003), which continues to represent the standard reference and a reliable source of inspiration for both theoreticians and experimentalists. Meanwhile, a wealth of new experimental results have been uncovered, involving many intriguing nonlinear elastic and viscoelastic effects, and multi-physics behaviours that are yet to be understood and explained.

The overarching aim of this Collection is to focus on important theoretical and computational challenges in the description and explanation of coupled phenomena in LCEs, and further enhance our way of thinking about soft responsive materials in general. By its intrinsic complexity and multidisciplinarity, the research presented here connects different areas of applied mathematics, engineering and physics, including but not limited to materials modeling, solid mechanics, soft matter, mathematical analysis, and scientific computing. Our Special Collection is dedicated to the memory of Professor Mark Warner, who pioneered the theoretical research of LCEs.

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Declarations

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