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Functionalizing liquid crystals for phononic, biophotonic and multiphysics devices

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The knowledge on the manipulation of energy is of core importance for research, technological innovation and industry. However, in many of the related devices, it is used different materials and configurations to build them, beyond that they are monopurpose and monophysics, dealing with one type of energy. An alternative to bypass these problems is the usage of liquid crystals: inanimate or living ones. In this work, we show our results on modeling and simulating three kinds of diode (thermal, bio-optical and thermal-optical), a sensor based on the thermal Hall effect and a thermal-optical controller. We found that the rectification effect of our diodes can be created by an escaped radial disclination confined in a capillary tube, having an asymmetric molecular director and asymmetric physical tensors (dielectric, thermal conductivity, etc.). This asymmetry, studied by classical and geometrical models, generates the thermal and optical rectifications. For such diodes, we study them made by 5CB and a chromonic liquid crystal hosting the bacterium Bacillus subtilis. The sensor based on the thermal Hall effect uses a hypothetic chiral biaxial nematic liquid crystal with a magnetic dipole composing a strip, with an initial longitudinal temperature gradient. We found that such system produces a The thermal-optical controller consists of 5CB confined between two concentric cylinders, where, due to the action of an applied electric field, it is allowed to switch between two molecular configurations. We found simultaneous concentration and repulsion of heat and light. Our results present new examples of manipulating heat, light and both simultaneously using liquid crystals, allowing one to apply such materials for developing devices that process more information at the same time.

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