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Direct mapping of local director field of nematic liquid crystals at the nano-scale YU XIA, FRANCESCA SERRA, SHU YANG, RANDALL KAMIEN, Univ of Pennsylvania — The director field in liquid crystals (LCs) has been characterized mainly via polarized optical microscopy, fluorescence confocal microscopy, and Raman spectroscopy, all of which are limited by optical wavelengths – from hundreds of nanometers to several micrometers. Since LC orientation cannot be resolved directly by these methods, theory is needed to interpret the local director field of LC alignment. In this work, we introduce a new approach to directly visualize the local director field of a nematic LC (NLC) at the nano-scale using scanning electron microscopy (SEM). A new type of NLC monomer bearing crosslinkable groups was designed and synthesized. It can be well-oriented at particle surfaces and patterned polymer substrates, including micron-sized silica colloids, porous membranes, micropillar arrays, and 1D channels. After carefully crosslinking, the molecular orientation of NLCs around the particles or within the patterns could be directly visualized by SEM, showing oriented nanofibers representing LC director from the fractured samples. Here, we could precisely resolve not only the local director field by this approach, but the defect structures of NLCs, including hedgehogs and line defects. The direct mapping of LC directors at the nanoscale using this method will improve our understanding of NLC local director field, and thus their manipulation and applications. More importantly, a theoretical interpretation will no longer be a necessity to resolve a new material system in this field.

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