A soft route to high-resolution liquid crystal vortex masks: developments and perspectives

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Liquid crystals combine high birefringence at optical frequencies, ability to be structured at will, and mature manufacturing processes after decades of progresses in liquid crystal displays. Nowadays, patterning liquid crystal technology holds a special place when dealing with singular beam shaping, with the advent of geometric phase liquid crystal optics, where space-variant optical anisotropy is exploited to shape the spatial properties of an incident beam. The generation of light beams carrying optical phase singularities is a prototypical example, which requires the precise creation of liquid crystal orientation patterns endowed with, ideally, an orientational topological defect, whose spatial resolution is in practice limited by the used fabrication tools. Here we will review how the basics of soft matter systems and their ability to exhibit a wealth of topological defects can be harnessed to establish a novel route to create high-resolution liquid crystal vortex masks without need of artificial spatial patterning techniques. Recent progresses and examples of applications of this self-engineered approach will be presented.