The beauty and utility of curved liquid crystals

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While the effects of curvature on liquid crystals have been studied for decades, recent advances in production and characterization technologies have given us new exciting opportunities to explore these effects, from a fundamental physics perspective and with technological application in mind. We use coaxial capillary microfluidics to produce liquid crystal shells, with isotropic liquids immiscible with the liquid crystal on the in- and outsides, and with electrospinning we make non-woven mats of core-sheath fibers containing liquid crystal in more or less cylindrical confinement. Nematic, smectic and cholesteric phases, subject to varying boundary conditions, are foci of our investigations, and we also polymerize the samples after production, partially or completely. With the latter step we can convert delicate liquid samples into long-term stable materials that can be easily handled. They may also exhibit new properties thanks to the polymerization. We will describe the many fascinating surprises that we encountered while studying these novel curved liquid crystal systems, as well as our current efforts to apply them, primarily in wearable non-electronic gas sensors [1], in security [2], and as unconventional actuators [3].

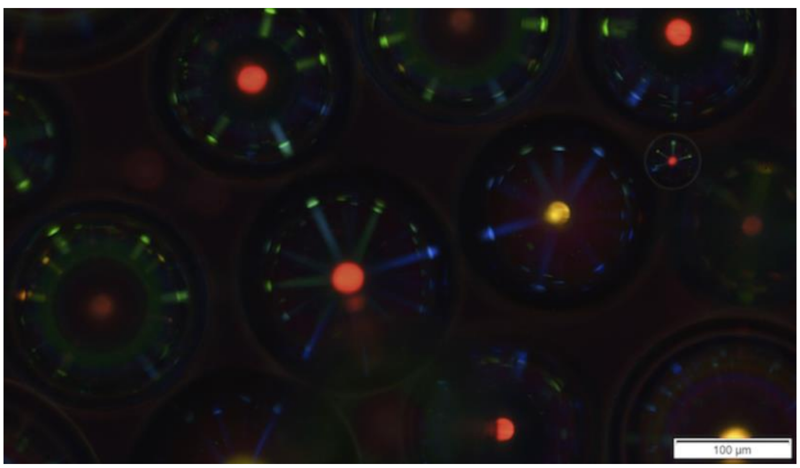

Fig. 1. Short-pitch cholesteric shells of varying composition, developing a complex photonic communication patterns that may find use in secure authentication [2].

References

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[3] Fleischmann, E.-K. et al., “One-piece micropumps from liquid crystalline core-shell particles,” *Nat. Commun.,* **3**, ARTN: 1178 (2012).

Speaker Biography

Jan Lagerwall was born in Göteborg, Sweden, where he also obtained his M.Sc. (Physics, 1997) and Ph.D. (Materials Science, 2002), both from Chalmers University of Technology. As a postdoctoral researcher he worked with N. A. Clark (CU Boulder), G. Heppke (TU-Berlin) and F. Giesselmann (U. Stuttgart). In 2007 he set up his first research group at Martin Luther University Halle-Wittenberg, moving to South Korea and Seoul National University in 2010. Since 2014 he is full professor in physics at the University of Luxembourg, leading the Experimental Soft Matter Physics group. His research focuses on soft matter physics, chemistry and materials science, revolving around liquid crystals but with many contact points with other fields, in particular polymer fiber spinning, microfluidics and nanoparticle research. The driving force is a deep fascination and enthusiasm for the scientific beauty of the field as well as the diverse application possibilities. Since 2015 he holds an ERC Consolidator Grant, working on a project that aims to demonstrate the potential to use liquid crystals in novel contexts, chiefly soft robotics and wearable technology.