Controlling light with liquid crystal metasurfaces

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Bottom-up metasurfaces are a class of unique optical materials that offer an unprecedented combination of low-cost fabrication, large-area scalability, and an intrinsic ability to manipulate and control light at the nanoscale. [1] These materials, engineered through self-assembly, provide tunable optical properties that can be tailored for a wide range of photonic applications. Liquid crystals, on the other hand, belong to a fascinating category of stimuli-responsive materials that dynamically modulate their optical properties in response to external stimuli such as electric fields, temperature changes, or light. Their ability to provide active control over otherwise passive optical components makes them ideal candidates for integration with engineered metasurfaces, enabling the realization of reconfigurable, multifunctional photonic devices. By combining bottom-up metasurfaces with liquid crystal phases, including nematic [2] and cholesteric [3], it is possible to create a new generation of light-controllable optical components that exhibit both structural and dynamic tunability. This hybrid approach enables active control of light propagation, polarisation, and reflection, opening new possibilities for fabricating colour filters.
In this presentation, I provide an in-depth overview of our recent achievements in bridging metasurfaces and liquid crystals, highlighting both the fundamental principles and the practical implementations of these hybrid systems. Furthermore, we explore an exciting application of this platform: the development of a new generation of solar cells capable of directly powering liquid crystal displays. [4]

References

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