Heliconical cholesteric liquid crystals: self-assembled tunable photonic bandgap materials

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Abstract:

In accordance with Floquet's theorem[1], the propagation of light is forbidden in materials with periodic dielectric structure for some range of wavelengths. The non-propagating light, if not absorbed, must be reflected. Materials with such reflection bands are useful for a variety applications. Materials exhibiting tunable bandgaps are of particular interest. The constituents of cholesteric liquid crystals self-assemble to form periodic dielectric structures exhibiting photonic bandgaps[2]. The location of the reflection bands is determined by the principal dielectric constants of the material and the periodicity of the structure[3]. If the elastic properties of the cholesteric liquid crystal fall within a specific range, the period of the resulting dielectric structure can be readily altered by applied electric[4] or magnetic[5] fields.

In these lectures, I will discuss models for the structures of helical and heliconical cholesteric liquid crystals and their dependence on external fields, as well as the connection between material structure and optical properties. Describing the optical response in terms of fundamental material constants allows the design of cholesteric mixtures with tunable photonic bandgaps[6] for applications such as agile filters and tunable mirrorless lasers[7].

References:

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