Self-Assembled Tunable Liquid Crystal Microlasers and Microresonators

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When liquid crystals are dispersed in an immiscible fluid, microdroplets or microfibres of liquid crystal are spontaneously formed in a fraction of a second. They have optically anisotropic internal structure, which is determined by the ordering of liquid crystal molecules at the interface. Spherical droplets of a nematic liquid crystal can function as whispering-gallery-mode microresonators with an unprecedented width of wavelength tuning\cite{1} by an electric field. WGM nano-second pulsed lasing in dye-doped nematic microdroplets is sensitive to strain, temperature and presence of molecules that change molecular orientation at the interface\cite{2}. Pulsed and omnidirectional 3D lasing was demonstrated in droplets of chiral liquid crystals that form 3D Bragg-onion resonators.\cite{3} Waveguiding and lasing from smectic-A self-assembled fibres was demonstrated recently.\cite{4} We present recent progress in this field, including:

- continuous electric tuning of 3D lasing from cholesteric microlasers.
- resonant transport of light between waveguides and liquid crystal resonators.\cite{5}

We also present recent experiments on all-optical control of the flow of light in LC photonic microelements, promising the realization of integrated liquid crystal photonics \cite{6}. 

![Figure 1. Electric-field-tuning of onion-Bragg optical micro-resonators. (a) A CLC droplet with a pitch p=7.4 µm under an applied electric field parallel to the viewing direction (i.e. perpendicular to the plane of the paper). (b) The electric field is applied perpendicular to the viewing direction, i.e. in-plane of the paper. (c) By gradually increasing the electric field, the lasing wavelength is shifted to shorter wavelengths; by decreasing the electric field to zero, the lasing wavelength returns reversibly to the starting point.](image)

References:


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