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Chiral Nematic Droplets for Lasing: Microfluidic Generation and Manipulation

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Chiral nematic liquid crystals (LC) can be used to form high quality, tuneable resonant cavities suitable for photonic band-edge lasing. This has normally been achieved by promoting a standing helix molecular structure in a glass cell, or with dried emulsions.[1] However, recent research has shown that droplets of chiral nematic LC in an immiscible host solution can also be used; the helical structure forms radially resulting in a 'spherulite' texture and omnidirectional laser emission.[2][3]

There are several different techniques for fabricating droplets, from simple mixing of emulsions to drop-on-demand microfluidics. Not all are optimal for producing lasing droplets with consistent optical performance. We report upon the use of microfluidic channel junctions as a repeatable method of fabricating monodisperse droplets of dye-doped chiral nematic LC. We are able to study the optical properties of the droplets during formation, whist flowing in a microfluidic channel, and in storage chambers of various dimensions. We also demonstrate directional laser emission from confined, non-spherical, droplets. Our findings will be discussed in the context of enabling applications of LC laser droplets.

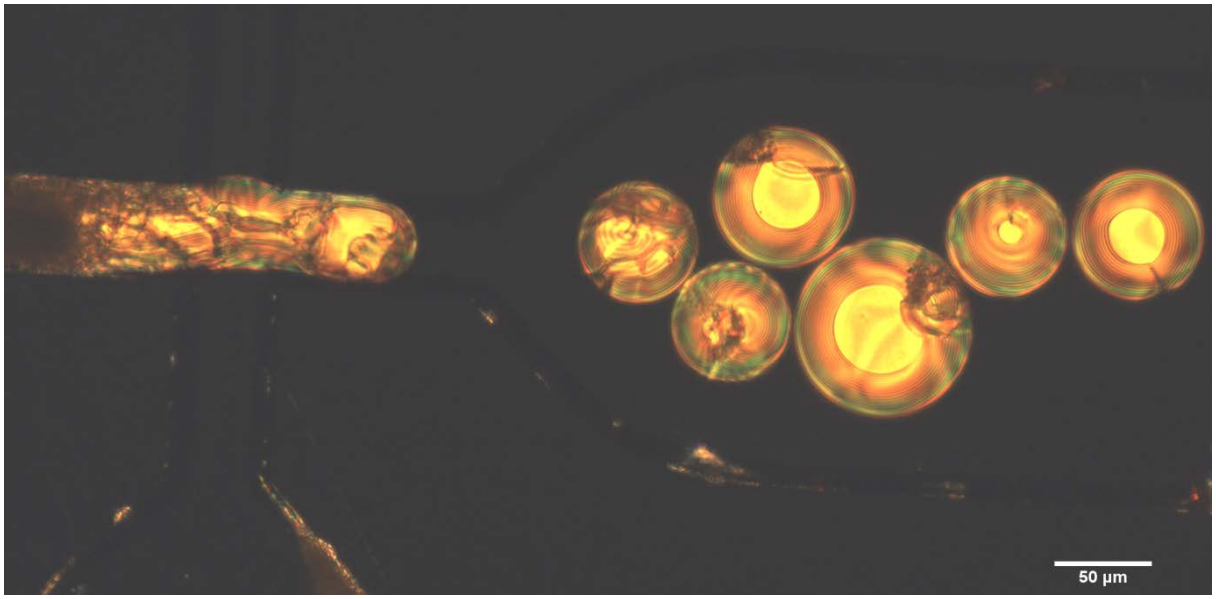

Figure 1 - Polarising optical microscopy of dye-doped chiral nematic LC droplets in a microfluidic channel.

References:

[1] D. J. Gardiner, S. M. Morris, P. J. W. Hands, C. Mowatt, R. Rutledge, T. D. Wilkinson, H. J. Coles, *Opt. Express*, **2011**, *19*, 2432–2439
[2] M. Humar, I. Musevic, *Opt. Express*, **2010**, *18*, 26995–27003
[3] M. Humar, F. Araoka, H. Takezoe, I. Muševič, *Opt. Express*, **2016**, *24*, 19237.