Electronically Tunable Photonic Crystals

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This paper presents what is believed to be the first example of a Photonic Crystal (PhC) structure with a rapid, electronically tunable lattice constant. The structure is tuned by applying a rotating electric field at a frequency of 1KHz. The PhC is formed from anionic polystyrene latex colloidal particles (~945nm diameter) synthesised by emulsion polymerisation and dispersed in a low viscosity aqueous phase. It is known that an AC electric field can induce a dipole moment in a colloidal particle [1] which can result in attractive forces. Particles with sufficient surface charge are electrostatically repelled from each other, preventing contact. [1] shows that a rotating AC field forms the particles into Hexagonal Close Packed (HCP) "rafts" which could possess in-plane photonic band gaps. Figure 1(a) shows an image of the HCP rafts and figure 1(b) shows a diffraction pattern obtained from normal incidence of a green laser. The expected six spot pattern is not obtained because of particle flow and random raft orientation. However, the radius of the pattern can still be used to determine the particle spacing. The graph shows a comparison between particle spacing obtained by direct optical measurement (●) and that calculated from the diffraction pattern (○). Work is now on-going to produce 3D tunable structures for use in display and signage applications.

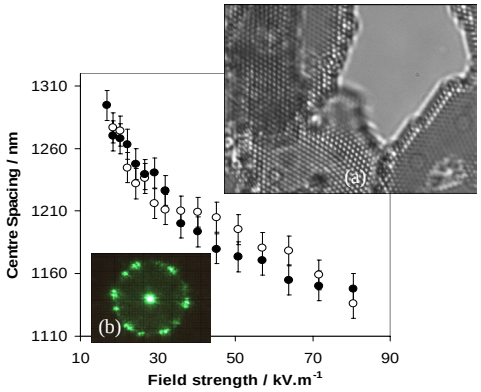

Fig 1 : (a)2D HCP rafts (b) Diffraction pattern and lattice constant tuning vs applied E field

[1] D.R.E. Snoswell *et al*, New J. Phys. 8, p. 267 (2006)