Mesogenic behaviour in suspensions of nano-particles

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It has been shown that suspensions of nano-particles can be aligned by magnetic fields (1), but mesogenic behaviour in these suspensions of organically modified clays could not be established since network formation due to edge-surface interactions prevented any long-range order. We have now made suspensions of rod shaped nano-particles in organic solvents which are stable and do not phase separate over time or under shear. In a sandwich cell, they usually appear scattering like polydomain crystals or liquid crystals, but interestingly, they form clearly birefringent regions around micrometer size air bubbles (see figure 1) and they exhibit defects similar to a nematic schlieren texture.
The most astonishing feature is that they can be switched to a macroscopically birefringent state in electric fields of low to moderate strengths and show strong birefringent effects when in-plane electrodes are used. Figure 2 shows the top view of a in-plane cell oriented at 45^{o} to crossed polarisers. The bright stripes appear in between the electrodes. The dark stripes are not caused by the electrodes, made from transparent ito, but by the orientation of the birefringent suspension. When one polarizer is taken out or the field is switched off the dark stripes disappear.
We report the electro-optic and magneto-optic switching characteristics of the dispersions in magnetic and electric fields, discuss the conditions for switching and arguments supporting the existence of a nematic mesophase formed by these suspensions.

References

(1) J. Connolly, J.S. van Duijneveldt, S. Klein, C.Pizzey, R.M. Richardson, *Journal of Physics: Condensed Matter, 19 (2007)*, 156103

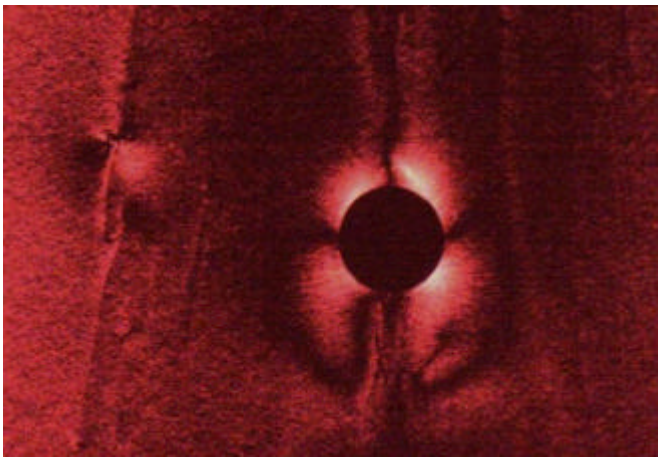

Figure 1: hedgehog defect around air bubble in a suspension of rods

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Figure 2 a)The same suspension between crossed polarizers when switched with in-plane electrodes and b) with one polarizer taken out and rotated.