Finite element modelling of liquid crystal devices and applications

F.A. Fernández, E. Willman, R. James, L. Seddon and S. E. Day
University College London, London, United Kingdom
e-mail: a.fernandez@ucl.ac.uk

Accurate modelling of the liquid crystal behaviour is vital for the design of complex devices where for example, LC orientation defects play a significant role in their operation. Liquid crystal in confined spaces, surface relief features and immersed particles are examples where defect structures appear. In many cases their effects caused by their presence are wanted, as in many types of bistable and multistable displays and in other cases they can seriously degrade the operation of the device. Appropriate modelling requires a proper (macroscopic) representation of the liquid crystal that allows an accurate study of defects. This work will describe a finite element implementation of the Landau-deGennes formulation [1-3] based on the order tensor and its applications to different kinds of devices. Fig. 1 (a-c) show different cases where defects occur. The defect structure inside a well of square cross-section inducing alignment in the bulk is shown in (a) while (b) shows two entangled particles immersed in LC when their “Saturn rings” merge. The switching of polymerised blue-phase II material is shown in (c). Combined with electromagnetic modelling, this modelling allows the study of wave propagation through structures containing LCs as in (c) that shows the field distribution in a meander microstip line phase shifter containing an LC substrate and operating at 60 GHz.

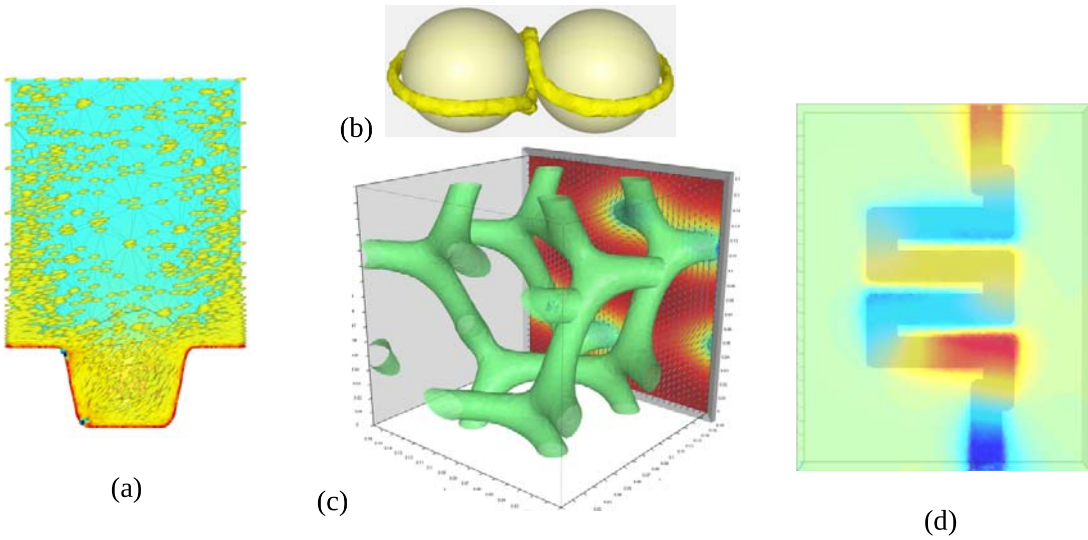

Fig. 1

References

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