Periodic textures of smectic-A films on crystalline surfaces

B. Zappone[a], E. Lacaze[b]
a Liquid Crystals Laboratory (LICRYL), CNR-INFM and CEMIF.CAL, University of Calabria, cubo 33B, 87036 Rende (CS) - Italy
b Institut des Nano-Sciences de Paris (INSP), UMR-CNRS 7588, Université Pierre et Marie Curie - Paris 6, 140 rue de Lourmel, 75015 Paris - France

Ordered textures of liquid crystal (LC) may be used as templates for the self-assembly of colloids and nanoparticles [1]. Using polarizing optical microscopy we studied thin films and droplets of smectic-A LC (8CB) deposited in air on crystalline surfaces of mica that induce monostable planar anchoring. The competition with the homeotropic anchoring at the LC-air interface leads to the formation of 1D patterns composed of straight, parallel defect domains that are organized in periodic arrays over areas as large as several mm^2. For higher values of h we observed a sharp transition to a 2D lattice of fragmented focal conic domains, without the axial symmetry typical of planar degenerate anchoring [3]. We have developed a simple model which identifies the 1D arrays with self-assembled "oily streaks," comprising straight disclination lines and curvature walls. The model reproduces the observed monotonic increase of the period p with the film thickness h in the range p=1–4 µm and h=0.8–17 µm [2]. Despite the apparent generality of our model for hybrid planar-homeotropic anchoring conditions, periodic arrays of straight oily streaks have been observed so far only for 8CB on crystalline surfaces such as mica or MoS_2. Our model indicates that this specificity is due to a particularly strong anchoring of the LC on such crystalline surfaces [3]. We discuss the arrangement of strongly deformed layers near the wall and the substrate in light of recent synchrotron x-ray diffraction measurements.

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