NANOIMPRINT ALIGNMENT OF LIQUID CRYSTALS

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Alignment of liquid crystals (LCs) in uniform domains is desirable in their application in display and organic electronic and photonics. Control of anchoring energy and tilt angle, and multi-stability have been achieved by nano rubbing or e-beam patterning of the surface of LC cells.[1-4] A drawback of using such techniques is the cost and time involved in preparing each surface. To avoid this, we have used nanoimprinting with thiol-ene photopolymerizable materials to prepare multiple micro/nano scale topographic patterns simultaneously. First, a mold was prepared by e-beam lithography and reactive ion etching. Then the mold was pressed on a substrate with a coating of thiol-ene material that is then polymerized by UV-light illumination. In this way, we prepared sub-micron scale topographic patterns, including square and rhombus grids and arrays of square buttes of various size and depth. We made nematic liquid crystal cells using the patterned films for one surface and films of GLYMO, octadecyltriethoxysilane self-assembled monolayers, or isotropic liquid on the other to minimize the effect of these surfaces on the pattern-induced alignment. The director field of the cells was studied by depolarizing transmission light microscopy. We observe homeotropic (vertical) alignment induced by deep, sub-micron scale checkerboard patterns (Figs. 1(a) and (b)), which can be explained by a model calculation of elastic energy and 2-D numerical simulation of average LC orientation (director) in the cell. The polar anchoring energy of the polymer was measured independently using a saturation voltage method.[5] Square grids and arrays of square buttes (Fig. 1(c)) show in-plane bistable alignment, which agrees with a model calculation minimizing the elastic energy of LCs confined in a square box.

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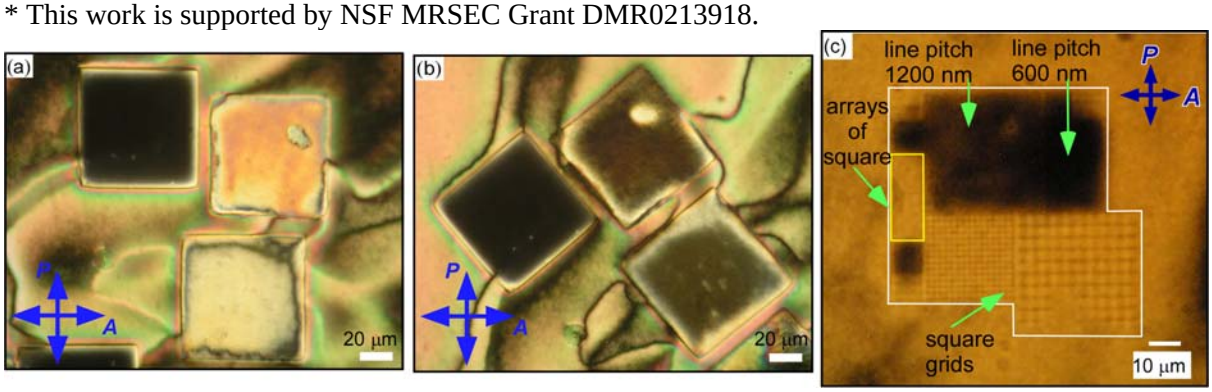

Figure 1 (a) Nematic liquid crystal texture by 200 nm, 600 nm, and 400 nm scaled checkerboard patterns from top to bottom squares. (b) The cell in (a) is rotated counterclockwise by 45˚. (c) LC texture by line patterns and 4-fold symmetry patterns.

References

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