Lithographic Alignment of Discotic Liquid Crystals: a New Time Temperature Integrating Framework

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Liquid crystals (LCs) are a successful example of how the control of self-assembling and self-organization[1] via chemical design[2] lead to new applications. These are mostly based on (quasi-) equilibrium properties as thermal stability, mesophase transition temperature, long-range molecular ordering and anisotropy. Here we present a new application of LCs based on non-equilibrium properties: a logic pattern which also records the thermal history of the system as a time temperature integrator. We control the multifunctionality of Discotic LCs (DLCs) by lithographic control to the self-assembling. DLCs are patterned into a "checker-board" of domains whose alignment differs from that of the surrounding dominant phase. Furthermore these domains are distributed as a "logic pattern" contains an information stored in binary code (Fig. 1). When the temperature overcomes the phase transition temperature $T_{r\text{-}h}$ between columnar rectangular and hexagonal mesophases, the domains progressively reorient into the dominant phase. The time spent above $T_{r\text{-}h}$ is monitored by optical microscope as the irreversible change of the local birefringence.

As $T_{r\text{-}h}$ is tuned by chemical design, a new application of non-equilibrium LC patterns as time-temperature integrators and as information storage media can be envisioned[3].

References

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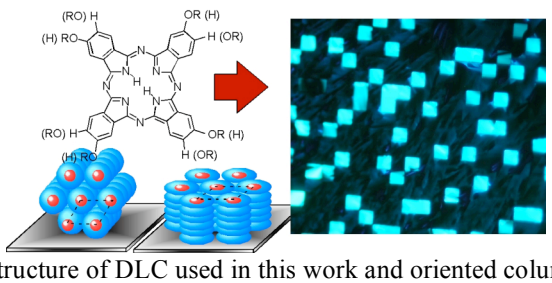

Figure 1. Left chemical structure of DLC used in this work and oriented columns on to a surface. Right optical micrograph with cross-polars of a pattrned thin film .