Smart windows with memory effect

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Objectives

Polymer dispersed liquid crystal (PDLC) films are a mixed phase of nematic liquid crystals (LC) commonly dispersed as inclusions in a solid polymer. PDLC can be switched electrically from an opaque scattering state to a highly transparent state when a film of LC-polymer mixture is sandwiched between two conductive glass slides. In most cases, after removal of the applied voltage, the film returns to its original opaque state. In particular cases, a high transparency state is obtained for a long period of time at room temperature even after the applied voltage has been switched off (permanent memory effect, PME). The main objective of this project is the production of PDLC devices with permanent memory effect. PDLCs with this answer permit to switch the transparency and keep the new state without spending any more energy. They seem to be a good selection for smart windows as they are lower power consumption and more environment friendly.

Methodology

The PDLC will be prepared by mixtures of monomers and liquid crystal (E7) with weight ratios of 30/70 and 1% of initiator. Samples will be prepared by introducing the mixtures by capillarity into a 20 µm ITO glass cell. The cell filled with the mixture will be polymerized by thermal or photochemical polymerization (polymerization induced phase separation (PIPS)). The monomers to be used include methacrylate, dimethacrylate and trimethacrylate, as the correspondent acrylates monomers, with long carbon chain or modified groups, either attached or within the primary chain of the monomer. Detailed characterization of monomers and films will be performed by elemental analysis, spectroscopy (NMR, FTIR), microscopy (SEM, POM), thermal properties (DSC) and electro-optical measurements. The characterization of these films will permit a better understanding of its structure and functioning; therefore its performance can be optimized by the choice of monomer and LC molecules.

Expected Results

We expected to synthesized several monomers as well as proceed to thermal and photo induced polymerization of corresponding composites (monomers, LC and initiator). With the physical-chemistry characterization of monomers and matrixes and electro-optical characterization of the corresponding PDLC systems; we pretend to achieve and understand the better conditions to produce PDLCs with higher permanent memory effect. According to previous results we pretend to attain PDLCs with high transparency state (T_{OFF}) for a long period of time at room temperature even after the applied voltage has been switched off, started from an opaque state (T_0) and after reaching a transparent state (T_{ON}). One of the last permanent memory effect device produced in our lab shows about 80% of permanent memory effect. This result is the highest one reported in the literature.

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