In-situ vertical alignment of nematic liquid crystals using photo-polymerizable acrylate mixtures

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Noncontact methods for the alignment of LCs have been a great topic of interest for last two decades. Photo-alignment [1] and doping of nanoparticles [2] have drawn much interest to modify the surface characteristics for the alignment of liquid crystal molecules. Recently, photo-responsive or -reactive additives doped to the nematic host have been developed to instigate a vertical alignment of LCs upon UV-light irradiation without using pretreated alignment layers [3]. Some efforts have also been made by photo-polymerizing acrylic monomers with different side chains [4,5]. In-situ control of alignment condition can be immensely important and useful for next generation flexible LC displays.

In this report, we present anchoring transition of nematic liquid crystal after polymerizing mixture of two acrylate monomers initially mixed in the nematic host. One polymerizable monomer, reported as PM1 in this report has two acrylate groups in one monomer unit. The other polymerizable monomer reported as PM2 in this report has one acrylate group in one monomer unit. Both the monomers are commercially available and have been bought from Sigma Aldrich. PM1 and PM2 have been mixed at 1: 9 weight ratio in a vial. 1.0 wt% of the monomer mixture has been added to a LC mixture with negative dielectric anisotropy. Cells have been fabricated using ITO-coated glass plates and 10 μm-thick tape spacers. Test cells have been filled with the LC mixture, doped monomer mixtures, at a temperature, a few degrees above TNI. One cell has then been examined under polarized optical microscope (POM). A random planar texture has been observed at room temperature. The filled cell has been heated to the temperature a few degrees above the nematic-isotropic transition temperature (T_{NI}) and then exposed to UV-light with the intensity of 200 μW/cm^2 for 1 hour. After irradiation of UV, the cell has been cooled under POM. A quick anchoring transition from random planar to homeotropic state has been observed just a few degrees below the T_{NI}. The cell has been washed in pure hexane to remove the LC mixture and then refilled again with the same LC in its pristine state. No planar texture has been observed after the refill. Hence it has been realized that the surface modification was permanent against solvent treatment and was strongly adhered to the ITO surface. The cell has then been un-assembled to study the surface morphology. The surface morphology has been performed by using FE-SEM and AFM. Another cell with optimized cell gap for the host LC has been fabricated and then has been irradiated under UV at isotropic temperature and similar anchoring transition has been observed. The electro-optic characteristics have been measured of the cell with optimized cell gap. The experimental details and results will be presented in the meeting.

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