PI-less Vertical Alignment with a Predetermined Director Tilt Achieved by *In Situ* Photo-Irradiation of Obliquely Incident Unpolarized UV-Light

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Vertically aligned nematic liquid crystal display (LCD) devices are getting highly popular because of its fast switching and wide viewing angle characteristics compared to traditional twisted nematic LCDs. With the development of vertically aligned LCs, polymer stabilization has become the most effective tool to enhance display performance. The reason behind polymer stabilization is to create a small director tilt with predetermined direction [1].This makes the LC response fast and uniform without forming transient defects during switching. One of the methods to create a large pre-tilt is evaporation of SiO by oblique incidence of ion beam [2]. However, this technique is not amenable to mass production and for large display panels. Previously reported, the generation of pretilt angle for nematic liquid crystal (NLC) by oblique ultraviolet (UV) light irradiation on polyimide coated aligned surface [3]. A recent work shows *in situ* creation of homeotropic alignment based on the photo-responsive azo-dye additives without using pretreated alignment layer [4].

In this present work, we report *in situ* predetermined tilt generation in nematic liquid crystal cell by oblique incidence of unpolarized UV without using pretreated alignment layers. *In situ* formation of homeotropic alignment layer with pretilt angle has been achieved by doping photo-chromic azo-dye in LC host and subsequent UV-light irradiation. The predetermined director tilt can be controlled by the irradiation angle of unpolarized UV-light. A very small amount of liquid crystalline photochromic azo-dye (0.5 *wt%*) has been mixed with a nematic liquid crystal with negative dielectric anisotropy. Conventional electro-optic (E.O.) cells have been fabricated using ITO-coated glass substrates and 10 μm tape spacers. No pre-treatment of the ITO surface has been made *prior to* cell assembly. The E.O. cells have been filled with the azo-dye doped LC mixture. The cells have been exposed to UV-light at the temperature five degrees above the T_{NI} of the mixture. The 350 ~ 400 *nm* unpolarized UV-light with the intensity of 20 mW/cm^2 has been used at different incident angle from the substrate normal. The E.O. characteristics have been characterized with optimized cell gap (3.8 μm). The surface morphology has been examined by using FE-SEM and AFM.

Upon UV-light irradiation, the E.O. cells show an anchoring transition of LC molecules. The LC director gradually reorients from the initial random planar to homeotropic state. The director tilt can be predetermined by the irradiation angle of unpolarized UV-light. For a normal incidence, the vertical alignment with no director tilt has been realized. For oblique incidences, however, director tilt has been stabilized along specific direction with respect to the irradiation direction. The director is tilted away from the normal in the same plane of irradiation. The irradiation and tilt angles do not coincide. The tilt angle can be manipulated approximately within 3~5 degrees. The resulting homeotropic alignment and director tilt are stable against heat and visible light treatments. The results and possible mechanism will be discussed during presentation.

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