Nanoparticles with High Permittivity Doped into Nano-sized Polymer Dispersed Liquid Crystals to Reduce Driving Voltage

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Polymer dispersed liquid crystal (PDLC) for realization of flexible displays have beed studied.[1-5] In case of traditional PDLC, because of scattering of liquid crystal (LC) droplet, it cannot be used for retardation layer. To reduce the scattering, the size of LC droplet should be decreased and ultimately required to optically isotropic state.[2] In this study, we have carried out the fabrication of nano-sized PDLC and confirmed the transparent PDLC in the initial state. LC droplet size was approximately 80 nanometers (nm). The PDLCs were fabricated by using a nematic liquid crystalline mixture (MLC-2053), the photo-responsive prepolymer (NOA 65) and a photo-initiator (Irgacure 651). To control the droplet size, we modulated a ultra-violet (UV) curing temperature and the concentration of LC and photo-initiator.[3] In order to verify the retardation of this PDLC, we used in-plane electrode formed by two domains between crossed polarizers. Fig. 1 shows that decrease of initial light leakages as LC droplet size was decreased. It can be concluded that a high contrast ratio (CR) is realized under the 200 nm LC droplet size due to reduction of the light scattering.[4] As LC droplet size was decreased, driving voltage was increased.[5] To lower the driving voltage, titanium dioxide (TiO_2) nanoparticles was doped in the polymer matrix of the PDLC cell with a high permittivity and size of 10~30 nm. In accordance with the increase in doping concentration of the TiO_2 nanoparticles, driving voltage was gradually decreased around 50% as shown in Fig. 2, but initial light leakage increased by aggregation of nanoparticles.

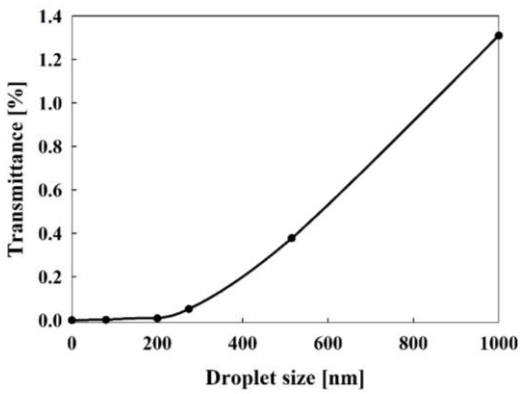

Fig. 1. Initial light leakage by LC droplet size

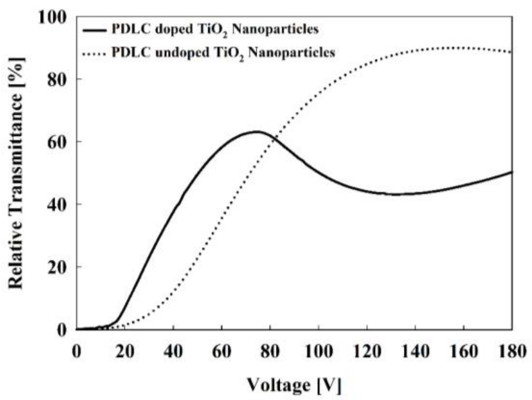

Fig. 2. Transmittance curve as a function of voltage

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