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Preparation and electrooptic study of reverse mode polymer dispersed liquid crystal: Performance augmentation with the doping of nanoparticles and dichroic dye

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ABSTRACT: Reported herein, the preparation, morphological, and electrooptic (EO) characterization of reverse mode polymer dispersed liquid crystals (PDLCs) with nematic liquid crystal (LC) and UV curable polymer optical adhesive using polymerization induced phase separation method. The PDLCs are switchable between transparent and opaque states due to the homeotropic and planar alignment of LC in their OFF and ON states of applied voltage, respectively. Further, effect of doping of a fixed concentration of azo dye and silica nanoparticles (NPs) on morphological, EO and response characteristics of same PDLC sample was also analyzed. Experimental results showed that doped reverse mode PDLCs have the higher OFF state optical transmission and boost up in the scattering ON state compared with pristine reverse mode PDLC. The phenomenon is also supported by extinction coefficient and absorption study based on Beer's law. The threshold and operating voltages were found reduced ~1.56 and ~1.73 times for NPs and (NPs + dye) doped reverse mode PDLCs, respectively, along with better contrasts to the pristine reverse mode PDLC. © 2019 Wiley Periodicals, Inc. J. Appl. Polym. Sci. **2019**, *137*, 48745.

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INTRODUCTION

Orientational controls and alignments of liquid crystals (LCs) have shown an intense impact on multipurpose display applications and polarization-sensitive optical switches.[1–3] The key alignments of LCs are homogeneous, homeotropic, and hybrid, which are being utilized for various electrooptic (EO) applications of LC in order to execute the purpose. In recent years, these EO materials based on polymer dispersed liquid crystals (PDLCs) are found advanced with their working operation in reverse mode with homeotropic alignment (HA) of LCs.[4–10] In reverse mode, PDLCs follow the mechanism of initial transmission of light owing to the homeotropically aligned LCs, whereas electrically tunable scattering of light deals with the transparent to opaque state of the PDLC film. As described by Rayleigh–Gans approximation, the scattering in PDLCs occurs when the LC droplet size is smaller than the wavelength of light used[11] and due to the mismatching of refractive index of LC with the refractive index of polymer.[9] A variety of studies on newly designed reverse mode PDLCs evolved from EO, morphological, photochromic behavior, and contrast ratio (CR)[9,12–19] have been reported. However, the preliminary report on a reverse mode PDLC showed adverse optical properties such as high driving voltage and low contrast.[20] Therefore to overcome to the hitches, different techniques for getting reverse mode PDLCs with HA of LCs have been proposed using positive and negative dielectric anisotropic LCs.[21,22] Alteration of glass surface by polyvinyl butyral layer,[23] photoalignment,[24] cetyltrimethylammonium bromide coatings on indium tin oxide (ITO) surfaces,[25] rough surfaces for orientational control,[13,26] and doping of ferromagnetic nanoparticles (NPs)[27] are few other reported techniques for reverse mode PDLCs. HA of LC molecules was also achieved by utilizing the polysulfone polymer[28] and surfactant (ionic and nonionic)[7] in PDLC mixtures. Besides, the encapsulation of monomer molecules in LC droplets