Double-layer negative dispersion retarder using negative birefringence materials

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We report a negative dispersion (ND) retarder using two negative birefringent materials. Generally, optically anisotropic materials have a positive dispersion (PD) of birefringence (Δn). PD means that birefringence of the medium decreases with increasing the wavelength (λ) of light. Δn is defined as n_e-n_o, where n_e and n_o are the extraordinary and ordinaty refractive index, repectively [1]. PD marerials have a different phase retardation $\Gamma \equiv 2\pi\Delta nd/\lambda$ at different λ and this degrade the performance of the compensation film. To overcome this problem, the retarder with ND of birefringence has been studied [2-3]. ND means that Δn is increasing with longer λ. Because Γ change is small over the wide range of λ, the ND retarder can be used for achromatic retarder.

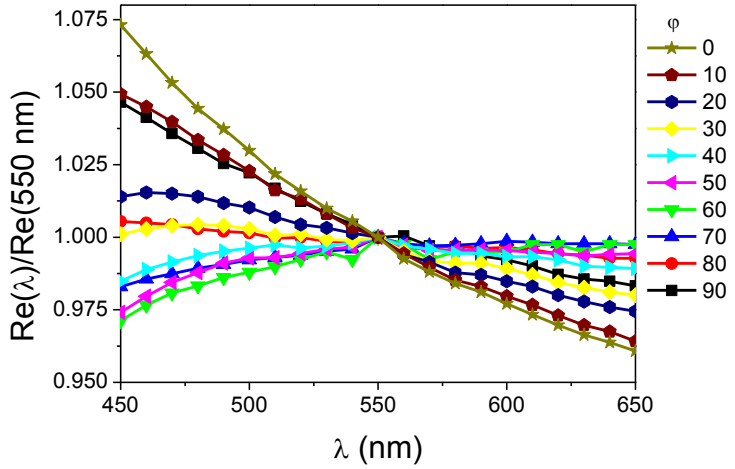

Fig. 1. Re(λ) of the PS-PMMA retarder normalized to Re(550 nm) at various φ vs. λ .

We made a double-layer ND retarder using two uniaxial films which were made of polystyrene (PS) and polymethylmethacrylate (PMMA). The PS film and the PMMA film had PD property whose Re(550 nm) were 245.7 nm and -134.4 nm, respectively. Figure 1 shows Re(λ) of the PS-PMMA retarder normalized to Re(550 nm). φ is angle between the extraordinary axes of the PS and the PMMA films. When the PS-PMMA films were stacked at φ=40˚, ND property was shown and Re(550 nm) was -273 nm. To make quarter-wave retarder film, the PS film was annealed at 70 ˚C and the Re(550 nm) of the PS film was decreased to -219.5 nm. When the annealed PS film and the PMMA film stacked at φ=70˚, ND property was shown and Re(550 nm) was -133.4 nm. To investigate the performance of ND retarder film, we simulated the PS-PMMA film for antireflection (AR) film of organic light emitting diode (OLED). The PS-PMMA film showed a low reflection value and an achromatic reflectance compare to commercial OLED AR film.

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