# 최적화된 위상지연층 이용한 파장선택형 회절격자

# Wavelength selective diffraction grating using optimized phase delay layer

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A wavelength selective diffraction grating using optimal phase delay layer and ultraviolet curable liquid crystal polymer has been proposed and experimentally demonstrated.

Diffractive optical elements based on surface reliefstructure can be used to realize a large variety of optical functions with high efficiencies. Especially, specific wavelength or polarization selective elements are demanded on the areas of optical data storage disk, spectroscopy, imaging systems, image filteringand optical information processing components. Polymers are widely developed because of their advantages, like as mechanical strength, stability, flexibility, low cost, and easy of processing. Furthermore, the promise of combining these properties with large optical anisotropy has prompted a great interest in liquid crystal polymer[1]-[3]. Recently, the appearances of the two-wavelength laser diode and Blu-ray disk accelerate the needs of wavelength independent diffraction grating because of the requirement of the simple optical scheme. In this work we report the wavelength selective diffraction grating by use of optimized phase delay layer and polarization selective gratings using birefringence of the liquid crystal polymer.

Optical scheme of the proposed grating shows in fig. 1. It consists of phase delay layer(PDL) for generating the orthogonal polarization beam, GT1 for $\lambda 1$ and second GT2 for $\lambda 2$. Phasedelay layer acts as a dummy glass with respect to the $\lambda 1$ and as a half waveplate with an optical axis of $45^{o}$ to the $\lambda 2$, so that polarization states of $\lambda 1$ and $\lambda 2$ have orthogonally changed after through the PDL. It could be obtained from appropriate phase delay value satisfying the condition of $2\pi m1$ for $\lambda 1$ and $2\pi(m2-1/2)$ for $\lambda 2$, respectively, where m1 and m2 are integer values. The polarization selective gratings consist of isotropic and anisotropic material. That is, anisotropic layer has different refractive index ne and no according to the input polarization states. That means each gratings operate as a dummy glass or diffraction grating if the refractive index of isotropic material same as ne or no. In our demonstrations, GT1 has experienced the x direction rubbing but GT2 has y direction rubbing. The refractive index of the isotropic material of GT1 has ne for the P-polarization light, but GT2 has index of no for the same polarization, so that only GT1 is affect on the wavelength $\lambda 1$. However, $\lambda 2$ is diffracted by GT2 because of the different polarization state, if the refractive index of the isotropic material same as no of the anisotropic material. In the results, it can be used as a wavelength selective diffraction grating(or DOE) by using optical scheme as shown in fig. 1. In our case, we use the liquid crystal polymer by

Merck(RMS03-001) as a anisotropicmaterial, so that refractive index difference is easily achieved by rubbing direction.

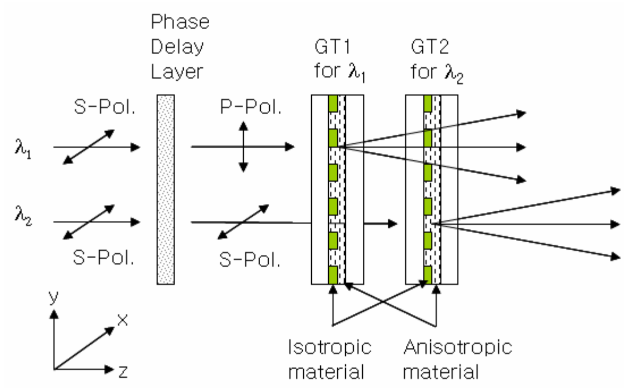
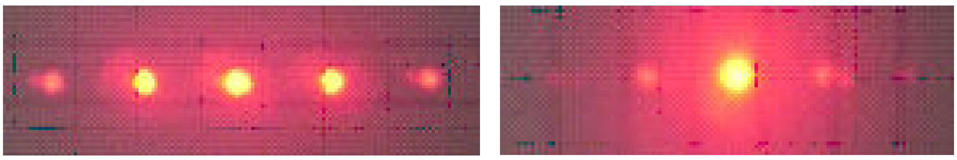



Fig. 1. Optical scheme of the proposed wavelength selective grating

Fig. 2 shows the diffraction configuration of the GT1 according to the polarization states. As shown in the figure, it has high efficiency when the P-polarization light is incident on the grating whereas the diffraction intensity has small value for S-polarization. The intensity ratios of GT1 are about 1.171 and 0.0072 for P- and S-polarization, respectively. Meanwhile, the GT2 for 780nm has the intensity ratio of 1.980 for S-polarization and of 0.0084 for P-polarization state. Because the refractive index of UV curable polymer is not exactly matched with no of anisotropic material, the diffraction beam could not be eliminated perfectly for the S-polarization.



(a) (b)

Fig 2. Diffraction configuration of GT1 (a) by P-polarization (b) by S-polarization

In summary, we hve successfully obtained the wavelength dependent grating according to the two wavelengths, 660nm and 780nm, which has been demonstrated by intensity ratio of the two gratings. Using proposed optical scheme, it is expected that proposed scheme will be used as various applications like as optical storage, optical interconnection and diffractive optical elements with multi-function.

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