포토폴리머에 새긴 홀로그램 회절격자의 회절효율 연구

Diffraction Efficiency of Holographic Grating on Photopolymer Film

강보영, 우정원, 김정훈*, 김은경*

이화여자대학교 나노과학부, *연세대학교 화학공학과

bobo@ewhain.net

Optical holography recording which ensures high storage density and fast data transfer rate is used in many applications for information technology of next generation. Among the holographic recording materials, photopolymers have attracted tremendous interest because of their high sensitivity, high resolution, long shelf life, dry real-time processing and low cost [(1)]. In this study, we investigate diffraction efficiency of holographic grating on photopolymer with changing the polymer content, intensity of incident beam, irradiation time and incident polarization.

The photopolymer consist sensitizer (Coumarin), initiator (iodonium salt + ig784), monomer (POEA + SEP) and bind polymer. When the interfered beam is incident into the sensitizer, sensitizer absorbs the beam and transfers energy to the initiator. The Fig.1 shows the absorption spectrum of the photopolymer film. The coumarin sensitizer absorbed visible light and the initiator absorbed the UV light. The initiator begins the polymerization of the monomer which is composited POEA (Ethylene glycol phenyl ether acrylate) and SEP (s-triazine diepoxy). The monomer polymerized and then formed the index modulation. The phtopolymer formed into a thick film which thickness is 200μm on slide glass with optimal composition.

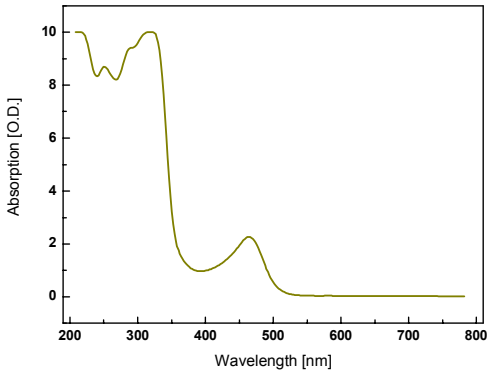

Fig. 1 The absorption spectrum of photopolymer film.

The holograms can be divided into two part base on Q-parameter.

$$Q = \frac{2\pi\lambda d}{n_0 \Lambda^2}$$

When Q <1, the hologram is decided a plane hologram and the diffracted beam follows the Raman-Nath

diffraction. The other case Q>1, the hologram is called volume hologram and obeys the Bragg diffraction. For this study, because the film thickness was 200μm and the grating period was 1μm so Q>1, the grating could be classified by volume phase grating[(2)].

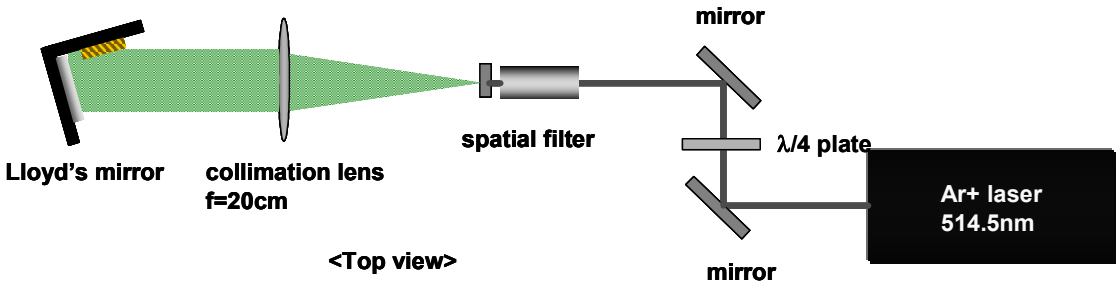

Fig. 2 A diagram of the Lloyd's mirror interferometer.

We made the transmission type hologram by using a Lloyd's mirror interferometer shown in Fig. 2. The incidence laser beam from 514.5nm Ar+ ion laser was spatially filtered and expanded and finally entered the Lloyd's mirror interferometer. The polarization of incidence beam was controlled by quarter wave plate. The grating period (Λ) can be readily varied by rotating the Lloyd's mirror assembly to change the incidence angle of the incoming laser beam onto the substrate.

The diffraction fringe of photopolymer holographic grating was identified by 633nm He-Ne laser. The diffracted amplitude is a maximum only when the Bragg condition is satisfied. The diffraction efficiency when the photopolymer film was exposed by interfered beam whose intensity was 0.062W/cm^2 for 5 minutes was measured as 93.65%. The polarization was adjusted by circular polarization. But the diffraction efficiency of a film that was made 5 month ago was 0.025% under fixed condition, which was much smaller than the diffraction efficiency of fresh film.

The diffraction efficiency depended on other facts such as the polarization, irradiation intensity, irradiation time and the time elapsed from film deposition.

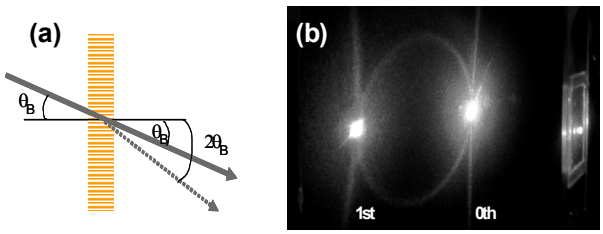

Fig. 3 (a) Bragg diffraction at Bragg angle (b) Diffraction fringe of photopolymer holographic

1. Sabino Piazzolla and B. Keith Jenkins, "Holographic grating formation in photopolymers" , Opt. Lett. **21**, 1075 (1996).
2. A. Yariv and P. Yeh, "*Optical waves in crystals" ,* (John Wiley & Sons Inc., New York, 1984), pp. 318.