실리카 광자결정과 액정을 이용한 파브리-페로 구조에서의 전기광학 특성 연구

Self-assembledsilicaphotoniccrystalasaliquidcrystal alignmentlayeranditselectro-opticapplication inFabry-Perotcavitystructure

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Photonic crystals (PCs) have an important photonics device application since the propagation of light inside PCs can be controlled by tailoring the photonic band gap (PBG) structure through the refractive indices of composing optical materials. Examples of active control through the PBG modulation include 1D and 2D PCs via Pockels effect[1] and 3-D PCs via reorientation of liquid crystals (LCs) infiltrated in PCs[2].

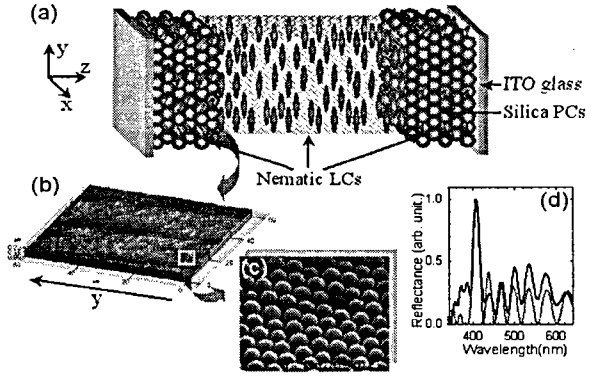

Figure 1.(a) Schematic illustration of the nematic LC cells fabricated with the PC films. The dipping direction of substrate into the silica suspension is defined as y-axis and x-axis is perpendicular to y-axis on the substrate plane. (b) AFM images for x-y plane of the PC film to see the surface microgrooves. (c) SEM image for a slightly tilted x-y plane of the PC film. (d) Reflection spectrum (black line) of the single self-assembled silica PC film. Gray line shows the calculated theoretical transmittance by using scalar wave approximation (SWA) method[3].

Related to the PBG structure filled with LC, the Bragg reflection band is studied in the cholesteric LC Fabry-Perot (FP) cavity[4] and a wavelength tunable laser has been demonstrated in FP cavity consisting of 1D Bragg mirrors containing dye-doped nematic LC as a defect layer[5]. In fabrication of FP cavity structures containing LCs, standard rubbed thin polymeric layers are prepared on top of dielectric Bragg mirrors for alignment of LCs. Hence in studying the optical property of LC-FP cavity structure, the PC structure is limited to 1D. In this study, we have investigated the LC alignment on silica 3D PC films fabricated by the self-assembly method. Figure 1 shows a schematic view of the nematic LC cell structure fabricated with 3D PCs. From the optical measurements for the LC cells made of PC films, it was proven self-assembled PCs align LCs. Moreover, we successfully demonstrated two LC devices fabrication by using the PC films for conventional TN devices and LC FP cavity in the spectral range of Bragg reflection band of PCs as shown in Figure 2. From these results, it is shown that self-assembled PC layer is an important system, which provides the possibility of alignment of LC molecules.

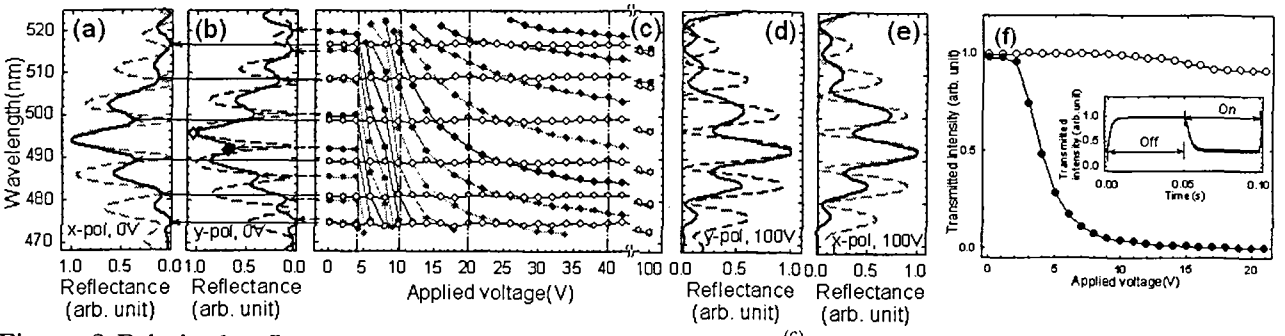

Figure 2. Polarized reflectance spectra of nematic LC (PA1109[6]) cells with PC film as a function of applied voltage: The experimental and theoretical results are displayed with solid and broken lines for (a) x-pol, 0V, (b) y-pol, 0V, (d) y-pol, 100V, and (e) x-pol, 100V. (c) Applied voltage dependence of the cavity-mode wavelength: x-pol (open circle) and y-pol (closed circle). (f) The T-V characteristics (transmitted intensities as a function of applied voltage) of the TN LCs (ZLI2293, Merck) on PCs sample cell. Inset: the measured optical transmittance at 5V from the sample cell as a function of time.

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