홀로그래피 식각법을 이용한 광자유체소자의 제조

Fabrication of Optofluidic Devices Using Holographic Lithography

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Recently, various periodic photonic nanostructures made of dielectric materials or metals have been studied extensively due mainly to their potential characteristics forhigh efficiency photonic devices and sensors. Electromagnetic waves striking into the periodic nanostructures have specific interactions which lead to various photonic properties such as photonic band-gaps (PBG), localized surface plasmon resonance (LSPR) and surface enhanced Raman scattering (SERS).

In this regard, major progress has been made in the fabrication of periodic nanostructures with simple and cheap way. The self-assembly of colloidal particles has been widely used to form a periodic nanostructure. Other microfabrication techniques, including layer-by-layer stacking, glancing angle deposition, and multi-photon absorption at near-IR, requires multiple steps to create 3D microstructures of almost arbitrary complexity. In comparison, multi-beam interference lithography, which is based on the optical patterning of photopolymers in a single exposure (a few nanoseconds to seconds), holds promise for the rapid production of highly ordered 2D and 3D structures with submicron periodicity defect-free over a large area. It allows for precise control of the size and shape of the resulting structures, and has the flexibility to access a variety of lattice symmetries through proper arrangement of laser beams.

Meanwhile, one of the remaining issues is to pattern the nanostructure. In this study, we reported a new strategy integrating holographic lithography with photo-lithography for hybrid patterns of microchannels and periodic nanostructures. In order to integrate as-fabricated holographic nanostructures into micropatterns such as microfluidic channels, additional photo-lithography step is used before or after HL step. These hybrid structures could be applied to an optofluidic platform utilizing a combination of the microfluidics and photonics. Holographically fabricated 3D structures have a photonic band-gap property due to their structural periodicity while microfluidic channels lendadaptive controllability of the refractive index. Since the photonic band-gap properties can be tuned by the refractive index mismatches between two different materials, they can be used as tunable waveguides and optical filters. Only a small amount of sample is needed in these optofluidic devices since the volume of the

microfluidic channel is on a nanoliter scale and the sample species can be detected immediately by optical signals associated with photonic band-gaps. Therefore, microscale optofluidic chips are useful for diagnostics and chemical or bio sensors with infinitesimal sample amounts.

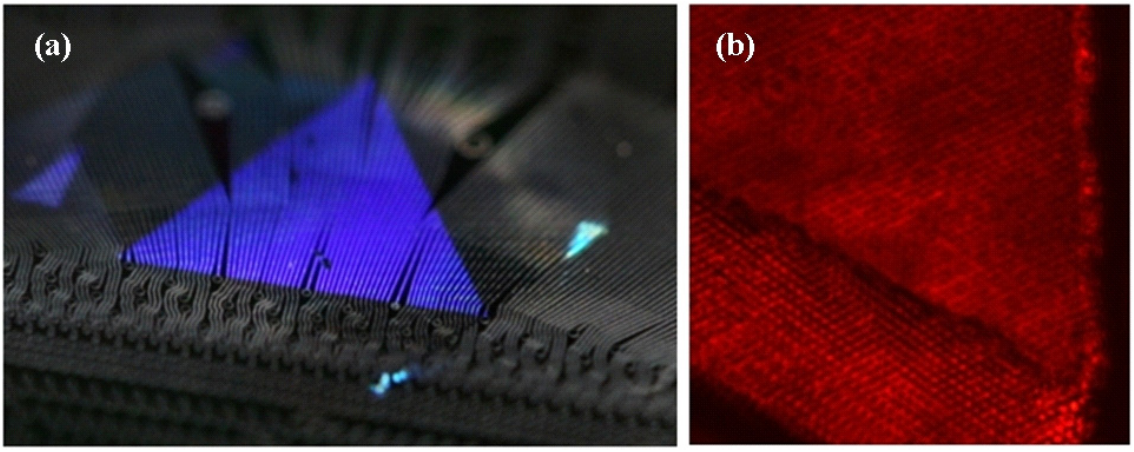

Fig. 1. Image of patterned photonic crystals (a) 2D photonic crystal diffracts blue color with microprocessor patterns. (b) Tilted view of patterned photonic crystal column taken by a confocal laser scanning microscope.

참고논문

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