Adaptive optically isotropic liquid crystal micro-lens with fast switching

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Polymer dispersed liquid crystal (PDLC) switchable lenses are known for fast switching and polarizer-free operation. In the PDLC switchable lens, LC droplets of 1μm diameter are dispersed in the polymer matrix. In the voltage-off state, the droplets are randomly oriented and light scattering is initially generated because of the refractive index mismatching between polymer matrix and LC droplets [1]. To overcome this problem, optically isotropic liquid crystal (OILC) switchable lens with small droplet size (< visible wavelength) were reported. By using OILC switchable lens, the light scattering was minimized in the voltage-off state and higher transmittance compared to conventional PDLC switchable lens was observed [2].

In this paper, we propose a novel OILC switchable lens with gradient refractive index. In the proposed OILC switchable lens, inhomogeneous droplet size distribution is achieved by ultraviolet (UV) light exposure through a lenticular film. The stronger UV light exposed area consists of smaller droplet size, while the weaker UV light exposed area has lager droplet size because of slower phase separation. The refractive index of area with large droplet size is higher than the area with small droplet size. Here, we achieved the lens performance by vertical electric field. To prepare the OILC cell, two flat indium tin oxide (ITO) substrates were attached. The cell gap is 50μm and the pitch of lenticular film is 270μm. Fig 1 shows charge-coupled device (CCD) intensity profile images of proposed OILC switchable lens. When $100V_{rms}$ voltage is applied, the focal length of proposed OILC lens is 5.3 cm.

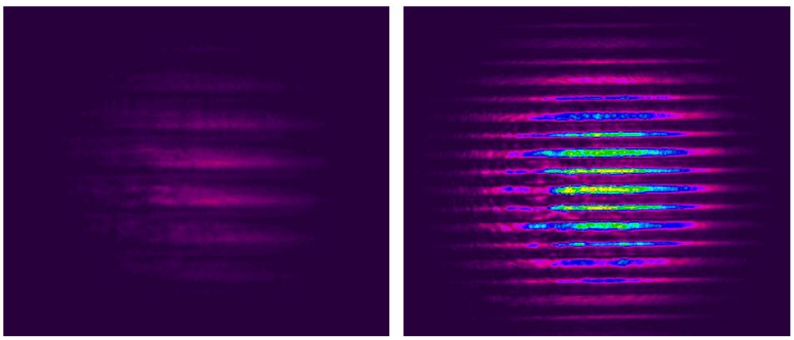

Fig. 1. The CCD intensity profile images of proposed OILC switchable lens in off and on states.

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References

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