Electric Field Dependent Focusing Properties of Microlens Array using Fast Switching SmA* Liquid Crystals

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Abstract

With the rapid progress in information technology, there is a need for real-time reconfigurable optical elements such as optical switches, beam-steering (e.g., diffractive gratings), and wave front shaping (e.g,microlens array) devices for use in high-density data storage, optical interconnects, beam modulating, and image integration components in 3-D displays [1-3]. In these devices, the electrically controllable focusing property is a key requirement. A number of attempts have been made to construct liquid crystal based real-time reconfigurable microlens array using various methods. But there are some problems such as slow response time due to by intrinsic nematic property or binary optical modulation due to by the hysteresis characteristics of surface stabilized ferroelectric liquid crystal[4]. We here demonstrate a new LC microlens array based on electroclinic effect of chiral smectic A liquid crystals[5]. The proposed micolens array consists of a focusing unit which modulates the beam focusing, and a tuning unit which controls the incident beam polarization. The focusing unit is composed by the stacked layer of liquid crystalline polymer (LCP) on the concave microlens structure of UV curable polymer. The chiral smectic LC is used for tuning of incident polarization The resultant microlens can be switched at a speed of a few microseconds. Moreover, as the induced tilt angle in the smectic A phase is changed to the linearly increasing electric field, the focusing beam intensity is linearly tunable with the applied electric filed. This fast switching microlens array is expected to be a key component for real-time processing optical systems.

References

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