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Polarization Independent Characteristics Micro-lens Arrays Based on Liquid Crystals

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Recently, 2D/3D switchable displays and tunable photonic devices is widely called the future display. Among them, Microlens Array based on Liquid Crystal has play important position to tunable focusing properties. So, it enables to control phase about each pixel. However, in most MLA, optical anisotropy of LC makes dependency upon the polarization of the incident light. Polarization dependency causes half of light to be involved focusing intensity. Also, If resulted device and MLA is not aligned, it has not characteristics of lens because axis of polarized light of device and effective refractive index of LC is not matched. To overcome these problems, orthogonally aligned LC Fresnel lenses [3,4] and vertically aligned (VA) LCs [5] have been proposed to increase the light efficiency by exploiting their polarization-independent properties. However, upon switching of the electric field, it is impossible to eliminate polarization dependency.

In this paper, we propose a optically isotropic MLA with tunable focal-length using nano-encapsulated LCs. Radii of capsule to covered LC are smaller than wavelength of the incident visible light. Because encapsulated LC layer has optically anisotropic properties, it has average refractive index of LC. First, In the initial state with no electric field, the refractive of index of the encapsulated LC layer is larger than that of polymer lens structure. So, it makes the incident light to be focused. Under application of an electric field, LC is aligned to parallel direction as electric field. Then, the refractive of index of the encapsulated LC layer is smaller than that of polymer lens structure. As a result, the incident of light is de-focused. For all MLA states, the proposed MLA has truly polarization-independent characteristics over the entire switching state.

References

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