performance of this method. As the diffraction efficiency is determined by the phase retardation of adjacent regions [14], the tuning property of the 12-fold symmetric structure is similar to that of simple periodic gratings. Good switchability of this structure is also achieved, as shown in Figs. 2(e) and 2(f).

Experimental results reveal the following advantages of our system: 1) Arbitrary pattern fabrication and local polarization control are practical. 2) High resolution of 5.5 μm has been reached. The theoretical optical resolution of current system is 1.4 μm, according to the DMD pixel size and the minification of the projection lens. By further optimization such as substituting the projection lens with one of higher magnification, resolution up to diffraction limit could be achieved. 3) With the projection system, the substrate is exposed at the focus plane; so beam expansion problem can be overcome. Therefore, even after the substrates being assembled to a cell, high quality replication can still be obtained, allowing instant control of the alignment [6]. 4) No mechanical movements are needed in multi-step exposure, avoiding the registration problem of conventional lithography technique.

Above advantages of this technique permit wide range of applications, from LC display to photonic fields. Quasicrystals are attracting considerable interests because of their high level of symmetry, which makes them excellent candidates of photonic bandgap materials [18]. This should be the first demonstration of quasi-periodic structures in LC, which opens a new door to realize tunable photonic crystal devices. The technique also enables locally control of polarization states, which is significant for the use in generating vector beams [20], realizing integrated [21] and multi-stable LC devices [19].

4. Conclusion

An approach to realize the patterned LC alignment in LC cell has been proposed and implemented. By utilizing the DMD based micro-lithography system we developed, arbitrary patterns have been fabricated including 1D and 2D periodic and quasi-periodic gratings. Comparable electro-optical tunability with previous work has been demonstrated. Besides, a polarization rotator array is realized. We believe this approach should be a very competitive photoalignment technique because it offers a simple way to fabricate arbitrary patterns alignment with high resolution, based on which wide applications of LC devices are practical.

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