

Hybrid-aligned dye-doped polymer network liquid crystals showing self-focusing effect

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Nonlinear optics (NLO) of liquid crystals (LCs) has drawn much attention due to its immense potential in applications. However, it typically requires high intensities and thus costly lasers. In 1990, it was reported that a small amount of dye molecules could greatly enhance the NLO response of LCs.¹ In 2013, our group found that the optical nonlinearity of dye-doped LCs could be further enhanced through polymer stabilization.² Recently, we discovered that the NLO response could be significantly improved by hybrid molecular alignment, which allowed us to use a hand-held low-power laser pointer to generate self-focusing effect.³ In this study, hybrid-aligned dye-doped polymer network LC (PNLC) was designed and its NLO response was evaluated, aiming to further reduce the threshold intensity for self-focusing effect.

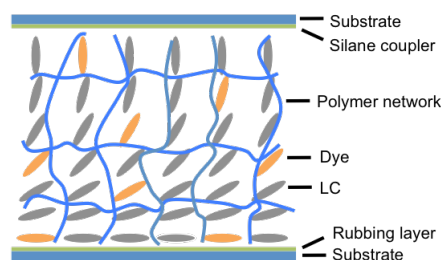


Fig. 1 Sketch of Hybrid-aligned dye-doped PNLC.

Polymer network LCs was achieved through photopolymerization of addition monomer and crosslinker. On the other hand, two substrates of the cell were treated differently for hybrid molecular alignment. We evaluated the self-focusing effect by self-diffraction ring measurement (Fig. 2a).

According to Fig. 2b, PNLC was very efficient at reducing the threshold intensity of self-focusing compared to PSLC. Furthermore, in the hybrid-PNLC, the threshold intensity decreased to 0.19 W/cm^2 by a factor of 9.8 compared to

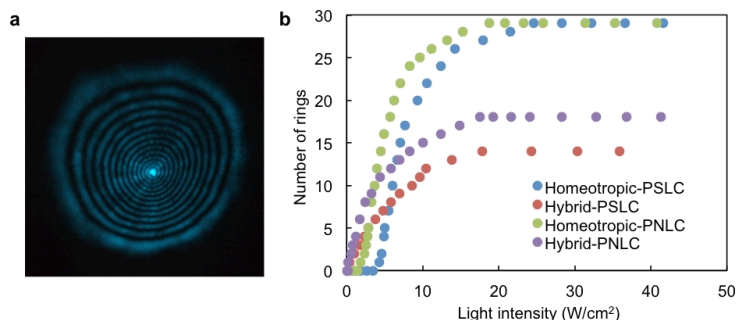


Fig.2. a, Typical diffraction ring. b, Number of diffraction rings as a function of light intensity.

homeotropic-PNLC. To our best knowledge, this threshold intensity is the lowest for self-focusing effect based on molecular reorientation. NLO response could be generated at much lower power, leading to a great expansion of NLO applications.

References

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