Formations and Applications of High-Performance Phase-Conjugate Mirrors in Cu-doped $(K_{0.5}Na_{0.5})_{0.2}(Sr_{0.61}Ba_{0.39})_{0.9}Nb_2O_6$ Photorefractive Crystals

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Optical phase-conjugate mirrors using photorefractive crystals are, by far, the most efficient devices for the generation of phase conjugate waves. In the present thesis a stable self-pump phase-conjugate mirror (SPPCM), high-performance double phase-conjugate mirrors (DPCMs) and their applications are studied in photorefractive Cu-doped $(K_{0.5}Na_{0.5})_{0.2}(Sr_{0.61}Ba_{0.39})_{0.9}Nb_2O_6$ (Cu:KNSBN) crystals.

At first the origin and elimination of dynamic instability are further studied in a Cu:KNSBN SPPCM. The theory and experiment show that the self-generated fanning effect can be decreased with a partially extraordinary-polarized input light. The dynamic instability can be eliminated by restraining the self-generated fanning.

The second subject concerns how to form a high-performance DPCM in Cu:KNSBN crystals. A high-performance Cu:KNSBN modified-bridge DPCM with low light loss and strong coupled strength is formed. In another aspect, for the crystals with different absorption coeffcients, the optimum incident geometries of the bridge DPCMs are discussed.

Next, a new type of multiple phase-conjugate mirror (PCM) consisting of a SPPCM and a DPCM is proposed in a Cu:KNSBN crystal. The performance of the multiple PCM is investigated. The real-time orthoscopic three-dimensional image projectionusing the multple PCM is achieved by performing two phase-conjugate operations on the incident image.

Finally, an all-optical switching dynamic interconnection is demonstrated using the arrangement of the multiple DPCMs in a Cu:KNSBN crystal. An all-optical routing switching dynamic interconnection is also achieved, in which the routing dynamic interconnection is swicthed by inputting different control beams.