

Cavity-Type Periodically-Poled LiNbO₃ Device for Highly-Efficient Third-Harmonic Generation

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Abstract : We develop a periodically-poled LiNbO₃ (PPLN) device for highly-efficient third-harmonic generation (THG), where the THG efficiency is enhanced with a cavity. THG can usually be produced via $\chi^{(3)}$ -nonlinear materials by optical pumping with very high pump-power. Instead, we here propose THG by moderate-power pumping through a specially-designed PPLN device containing only $\chi^{(2)}$ -nonlinearity, where sum-frequency generation in the $\chi^{(2)}$ process is employed for the mixing of a pump beam and a second-harmonic-generation (SHG) beam produced from the pump beam. The cavity is designed to increase the SHG power with dichroic mirrors attached to both ends of the device that perfectly reflect the SHG beam back to the device and yet let the pump and THG beams pass through the mirrors. This brings about a THG-power enhancement because of THG power proportional to the enhanced SHG power. We examine the THG-efficiency dependence on the mirror reflectance and show that very high THG-efficiency is obtained at moderate pump-power when compared with that of a cavity-free PPLN device.

Keywords : cavity, periodically-poled LiNbO₃, sum-frequency generation, third-harmonic generation

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