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Research Article

Noise Analysis of Second-Harmonic Generation in Undoped and MgO-Doped Periodically Poled Lithium Niobate

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Abstract

Noise characteristics of second-harmonic generation (SHG) in periodically poled lithium niobate (PPLN) using the quasiphase matching (QPM) technique are analyzed experimentally. In the experiment, a0.78 μm second-harmonic (SH) wave was generated when a 1.56 μm fundamental wave passed through a PPLN crystal (bulk or waveguide). The time-domain and frequency-domain noise characteristics of the fundamental and SH waves were analyzed. By using the pump-probe method, the noise characteristics of SHG were further analyzed when a visible light (532 nm) and an infrared light (1090 nm) copropagated with the fundamental light, respectively. The noise characterizations were also investigated at different temperatures. It is found that for the bulk and waveguide PPLN crystals, the SH wave has a higher relative noise level than the corresponding fundamental wave. For the same fundamental wave, the SH wave has lower noise in a bulk crystal than in a waveguide, and in MgO-doped PPLN than in undoped PPLN. The 532 nm irradiation can lead to higher noise in PPLN than the 1090 nm irradiation. In addition, increasing temperature of device can alleviate the problem of noise in conjunction with the photorefractive effect incurred by the irradiation light. This is more significant in undoped PPLN than in MgO-doped one.