Optical Parametric Process in the Far-infrared

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Terahertz (THz) radiation, spanning the spectral range between 0.1 and 10 THz, lies between the microwave and infrared regions of the electromagnetic spectrum. This thesis aims to develop a high-efficient and broadband THz source. For example, we focus on a source based on polariton parametric scattering in polar materials like lithium niobate (LiNbO3, LN) pumped by a femtosecond laser pulse centered at 1 µm. The approach involves engineering the structure dispersion by designing a LN waveguide. In an appropriate LN waveguide, the generated THz radiation can be guided and generated efficiently due to the optimized effective refractive indices of the THz modes matching the group index of the pump infrared light. Once the phase-matching condition is met, the infrared-to-THz conversion efficiency is enhanced.

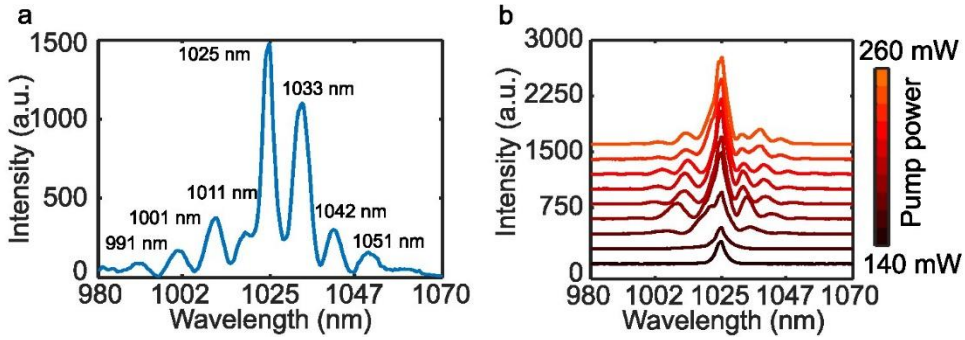

Figure 1 (a) Stokes and anti-Stokes signals when 260 mW pump power is injected in the waveguide. (b) Spectra measured over a range of pump power from 260 mW to 180 mW. Curves are shifted relatively for clarity.

Due to the conservation of photonics energy, infrared lights with frequency shift also appear in addition to THz radiation in the polariton parametric scattering process. We started to investigate the nonlinear interaction of the pump pulse in a 15 mm long LN waveguide with a 0.5x0.5mm^2 cross-section. As shown in the figure 1, multiple Stokes and anti-Stokes signals on sides of the pump peak (at 1025 nm) have been observed. The Stokes and anti-Stokes signals only appear when pump power exceeds a certain threshold, which confirm the nonlinearity of the process.