1um 帯スーパーコンティニュームを用いた波長可変中赤外光周波数コム光源の開発

Tunable mid-infrared optical frequency comb source based on supercontinuum at 1um wavelength range

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The recent development of Yb-fiber laser and amplifier systems provide novel, stable and economic solutions for pumping the picosecond and femtosecond difference-frequency generators (DFG) operating at the band of mid-IR [1], which is a critical spectral band for the characteristic vibrational absorptions of organic materials [2]. In this paper, we report a DFG comb generation at wavelength from 2.9-4.7 μm, which was continually tunable by controlling the optical path difference in a delay line.

Mid-IR comb generation of our experiments is based on the DFG in a PPMgSLT crystal with temperature controller. The experimental setup is shown in Fig. 1. An Yb-fiber oscillator with a repetition rate of 184 MHz was working as a seed source. The chirped pulses centered at 1040 nm were amplified by a double-clad Yb-fiber amplifier pumped by a high power laser diode, which could provide a pump power of 8 W. By a pair of transmission gratings, the pulses were compressed into 190 fs (FWHM). Coupling the compressed pulses into a PCF with normal dispersion property, the supercontinuum (SC) from 900 nm to 1200 nm was broadened. The PPMgSLT was designed for the DFG working at the wavelength centered at 4.5 μm. By carefully adjusting a delay line at the output of the PCF, the two pulses at the wavelength of 900-1000 nm and 1000-1200 nm respectively were overlapped in space and time, and then focused into the PPMgSLT crystal. By tuning the optical path difference in one arm of the delay line, the generated mid-IR could be changed from 2.9 μm to 4.7 μm, as shown in Fig. 2. The relation between the relative time delay of the delay line and the center wavelength of DFG spectra is shown in Fig. 3. Because the SC was generated from the PCF with normal dispersion, the center wavelength is a monotone increasing function of relative time delay.

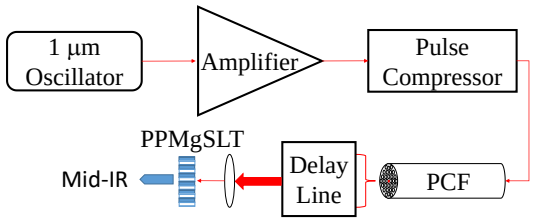

Fig. 1 The experimental setup of mid-IR comb generation

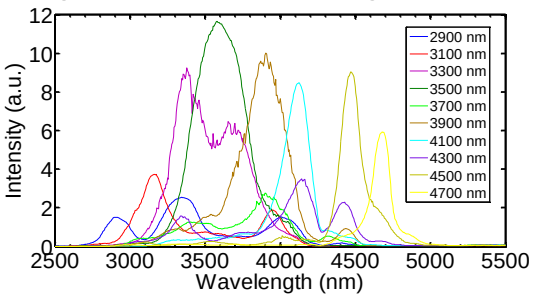

Fig.2 Wavelength shift of the Mid-IR.

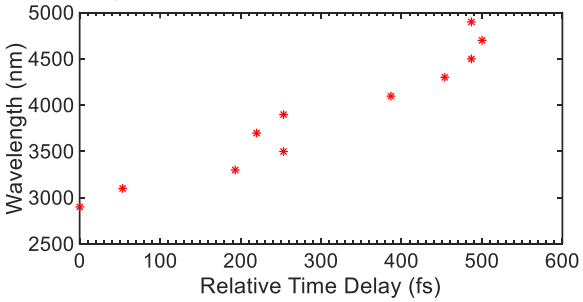

Fig.3 Relation between the relative time delay and the center wavelength

Ref: [1] M. Beutler, et al., Opt. Exp. **23**, 2730 (2015). [2] M. Papantonakis, et al., Appl. Phys., A Mater. Sci. Process. **79**, 1687 (2004).