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1um 帯スーパーコンティニュームを用いた高コヒーレンス波長可変中赤外光周波数コム光源の開発

Highly coherent tunable mid-infrared optical frequency comb seeded by high power supercontinuum at 1 μm

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With the developments of stable and efficient fiber laser and amplifier systems, the wavelength tunable optical frequency comb has been realized in mid-infrared (MIR) region [1-3]. Compared with seeding difference frequency generation (DFG) crystal by optical parametric oscillators or Raman solitons, a more reliable method to generate MIR comb with high coherence and stability is the scheme using supercontinuum (SC) pulses. In this work, we demonstrated a highly coherent MIR comb with a maximum wavelength tunability of 2.9-4.7 μm. High coherence of the MIR pulses generated from SC seeds was verified experimentally, and a fringe visibility of 0.90 was observed.

MIR generation in our experiments is based on a PPMgSLT crystal designed for the DFG working at the wavelength centered at 4.5 μm. The experimental diagram is shown in Fig. 1. With the compressed high power pulses (3 W), the SC from 900 to 1200 nm was generated in a photonic crystal fiber (PCF) with an average power of 1.3 W. By tuning the optical path difference in a delay line, the peak wavelength of generated MIR comb could be changed from 2.9 μm to 4.7 μm, as shown in Fig. 2. The temporal coherence examination of generated MIR pulses were performed by a Michelson interferometer. By moving a mirror in one arm of the Michelson interferometer, the one-pulse-delay time coherence of the generated MIR was recorded by the monochromator working at the fixed wavelength mode. Figure 3 shows the interference fringe of the adjacent pulses, which is corresponding to the generated MIR at wavelength of 4.0 μm. The fringe visibility of 0.90 was observed. This is a direct evidence of the coherence, which is the highest fringe visibility reported in MIR region to the best of our knowledge.

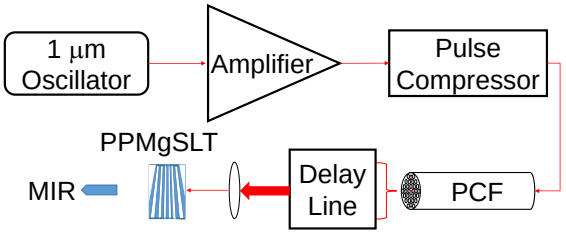

Fig. 1. Experimental diagram of MIR comb.

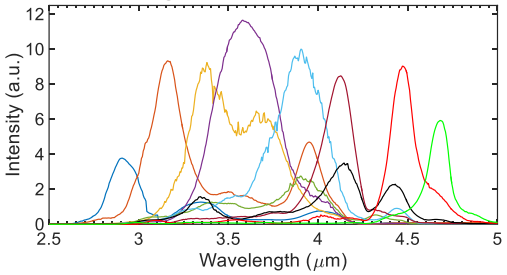

Fig.2. Wavelength shift of the Mid-IR.

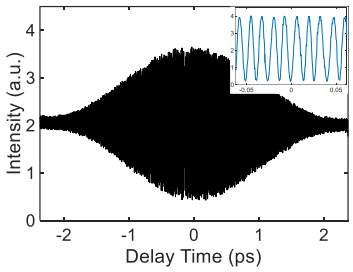

Fig. 3. Interference figure at the output of the Michelson interferometer. Inset is the high resolution result.

Ref: [1] T. W. Neely, et al., Opt. Lett. 36, 4020 (2011). [2] A. Ruehl, et al., Opt. Lett. 37, 2232 (2012).

[3] A. Gambetta, et al., Opt. Lett. 38, 1155 (2013). Mater. Sci. Process. **79**, 1687 (2004).