HIGH-POWER MID-IR COMB GENERATION FOR CAVITY-ENHANCED 2DIR SPECTROSCOPY

MYLES C SILFIES, *Department of Physics, Stony Brook University, Stony Brook, NY, USA*; YUNING CHEN, *Department of Chemistry, Stony Brook University, Stony Brook, NY, USA*; HENRY TIMMERS, ABIJITH S KOWLIGY, ALEX LIND, SCOTT DIDDAMS, *Time and Frequency Division, National Institute of Standards and Technology, Boulder, CO, USA*; THOMAS K ALLISON, *Department of Chemistry, Stony Brook University, Stony Brook, NY, USA*.

Using frequency combs and optical cavities, we have previously demonstrated ultrafast transient absorption measurements with a detection limit of $\Delta\text{OD} = 1 \times 10^{-9}/\sqrt{\text{Hz}}$, enabling work in dilute molecular beams.[a] Similar methods can be applied to multidimensional spectroscopy as well.[b] Since molecules undergoing ultrafast dynamics have broad spectral features, cavity-enhanced ultrafast spectroscopy then demands broadband and widely tunable frequency combs. Here we present a frequency conversion setup for the generation of high power mid infrared frequency combs in the 3-10 μm region. The initial comb is generated using an Er:fiber oscillator with 100 MHz repetition rate. After nonlinear amplification, the comb is shifted in a highly nonlinear fiber (HNLF) to 1 μm and amplified to 10 W in a home built, multi-stage Yb:fiber amplifier. We have measured the output comb tooth linewidth to be less than 10 kHz and the pulse duration is 120 fs. This laser is then used as a pump for several nonlinear difference frequency generation stages seeded by additional HNLF-shifted combs. Cavity-enhanced mid-infrared combs in the 3-5 μm region will be applied to studying ultrafast dynamics of hydrogen-bonded clusters.

---

[a] M. A. R. Reber, Y. Chen, and T. K. Allison, Optica **3**, 311 (2016).
[b] T. K. Allison, J. Phys. B: At. Mol. Opt. Phys. **50**, 044004 (2017).