HARMONIC FREQUENCY COMB COVERING THE MID-INFRARED MOLECULAR FINGERPRINT REGION

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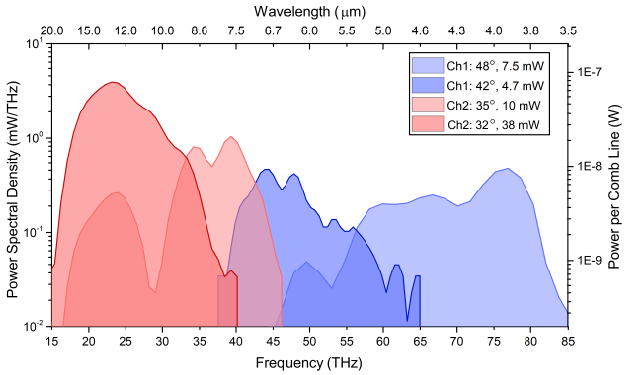

We present a multi-channel harmonic frequency comb covering the mid-infrared spectral range between 15 and 85 THz (or 3.5 - 20 μm, or 500 to 2860 cm^{-1}) with a record 1-mW/THz-level power spectral density. An Er-fiber-based oscillator is wavelength-shifted to a central wavelength of 1960 nm and a chirped-pulse Tm-fiber amplifier provides a 50-MHz-repetition-rate train of 250-fs pulses with 120 W of average power. Nonlinear self-compression in two fused-silica fibers results in two channels, yielding 11-fs pulses with 4.5 W (Channel 1) and 25-fs pulses with 25 W (Channel 2). Subsequent intrapulse difference-frequency generation (DFG) in 1-mm-thin GaSe crystals results in a coverage of the entire molecular fingerprint region with only two phase matching angles for each channel (see Figure). DFG inherently provides phase-stable pulses, leading to a harmonic frequency comb. The 120-W average power of the near-infrared frontend suffices for the parallel implementation of multiple channels, facilitating broadband spectroscopy.