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Recent progress in mid-infrared fiber lasers at 3 μm

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Compact and efficient mid-infrared (IR) laser sources have attracted significant interests due to their practical and potential applications in spectroscopy, remote sensing, material processing, IR countermeasures, laser surgery, and pump sources for nonlinear wavelength convertors. Among various mid-IR laser platforms, fiber lasers offer advantages such as inherent simplicity and flexibility, high efficiency, outstanding heat-dissipating capability, and excellent beam quality, and have been extensively studied during the last few decades. In particular, mid-IR fiber lasers at 3 μm have been successfully demonstrated with erbium (Er3+), holmium (Ho3+), and dysprosium (Dy3+) ions doped into ZrF4–BaF2–LaF3–AlF3–NaF (ZBLAN) fibers and recent advances in output power scaling have resulted in continuous-wave (CW) operation at 20-W level. Mid-IR pulsed lasers with peak powers some orders of magnitude higher than in the CW regime are highly desired for some applications aforementioned. Q-switched and mode-locked mid-IR fiber lasers have become an attractive research topic in recent years and various Q-switched and mode-locked fiber lasers at 3 μm have been demonstrated by using different passive and active modulation devices. These remarkable achievements will enable the implementation of mid-IR fiber lasers in a variety of applications. In this talk, recent progress in Q-switched and mode-locked fiber lasers at 3 μm will be presented and their further development and possible applications will be addressed.

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Toward generation of high power ultrafast white light laser using femtosecond terawatt laser in a gas-filled hollow-core fiber

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In this work, we could experimentally achieved the generation of white-light laser pulses of few-cycle fs pulses using a neon-filled hollow-core fiber. The observed pulses reached 6-fs at at repetition rate of 1 kHz using 2.5 mJ of 31 fs femtosecond pulses. The pulse compressing achieved by the super continuum produced in static neon-filled hollow fibers while the dispersion compensation is achieved by five pairs of chirped mirrors. We showed that gas pressure can be used to continuously vary the bandwidth from 350 nm to 900 nm. Furthermore, the applied technique allows for a straightforward tuning of the pulse duration via the gas pressure whilst maintaining near-transform-limited pulses with constant output energy, thereby reducing the complications introduced by chirped pulses. Through measurements of the transmission through the fiber as a function of gas pressure, a high throughput exceeding 60% was achieved. Adaptive pulse compression is achieved by using the spectral phase obtained from a spectral phase interferometry for direct electric field reconstruction (SPIDER) measurement as feedback for a liquid crystal spatial light modulator (SLM). The spectral phase of these super continua is found to be extremely stable over several hours. This allowed us to demonstrate successful compression to pulses as short as 5.2 fs with controlled wide spectral bandwidth, which could be used to excite different states in complicated molecules at once.

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