Advances of ultrashort-pulse fiber lasers using nanocarbon-based saturable absorbers

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Optical pulsed lasers offer a broad-range of applications in various fields, such as optical communications, optical signal processing, nonlinear microscopy, optical metrology, laser surgery, etc. Passively mode-locked fiber lasers are amongst the best pulsed sources available today due to their simplicity and their ability to generate transform-limited ultrashort optical pulses in the picosecond and sub-picosecond regimes. Such lasers offer superb pulse quality and there is no need for costly modulators as required in actively mode-locked lasers. Instead, passively mode-locked fiber lasers employ a saturable absorber (SA) as a mode-locker, a device that possesses an intensity-dependent response to favor optical pulse formation over continuous-wave lasing. Although saturable absorption itself is a common phenomenon happening in any absorbing materials, it is not easy to find a fast SA responding at timescales of 1ps or faster suitable for ultrashort-pulse generation. Conventionally, semiconductor-based SA (semiconductor saturable absorber mirror (SESAM)) or fiber Kerr-based SA (nonlinear polarization rotation (NPR) or nonlinear loop mirror (NOLM)) has been used. The third SA is the CNT-based SA, which was proposed in 2003. CNT-based SAs have been demonstrated to have significant advantages over the former SAs for passively mode-locked fiber lasers. It was also discovered that graphene and other 2D materials have similar fast saturable absorption and are applicable to passively mode-locked fiber lasers.

In this talk, we will review our recent advances on ultrashort-pulse fiber lasers using nanocarbon-based SA and their applications. The talk will mainly focus on

(1) Fabrication of nanocarbon-based SA device
(2) SWCNT@BNNT-based SA having high optical damage threshold
(3) Dual-comb fiber lasers using CNT-based SA

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