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Editorial: Ultrafast Photonics of Low-Dimensional Materials

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Editorial on the Research Article

Ultrafast Photonics of Low-Dimensional Materials

Ultrafast photonics is widely used in many fields, including optical fiber communication, femtosecond laser imaging, national defense military, biomedicine and mechanical processing. The wide application of graphene has successfully opened a new era of low-dimensional materials. Low-dimensional materials with atomic layer thickness can not only exist stably, but also have many unique characteristics. With the extensive research of the non-linear optical properties of low-dimensional materials, a series of potential applications of low-dimensional materials as saturable absorbers (SAs) in optical devices have been demonstrated and realized.

This issue of "ultrafast photonics of low-dimensional materials" covers some of the latest progress and achievements in the application of low-dimensional materials in ultrafast photonics. In six original research articles and one review, the theoretical and experimental studies of low dimensional materials related to optics, photonics and optoelectronics are introduced in detail.

Zhang *et al.* realized passive Q-switched mode-locked operation in Tm, Ho: CaYAlO4 bulk laser for the first time using double walled carbon nanotubes (DWCNT) as SAs. The experimental results show that DWCNT-SAs can be used as a fast starting element for passively Q-switched mode-locked solid state laser of 2 μm band [1]. Xu *et al.* prepared PbS-doped ring-core fiber by improved chemical vapor deposition method, and proposed an orbital angular momentum (OAM) optical amplifier based on ring core PbS doped fiber. The experiment confirms that the air-hole PbS-doped ring-core fiber can support the OAM $|l| = 1$ modes (l is eigenvalue) [2]. The optical limiting properties of reduced graphene oxide have been restricted to visible light. Li *et al.* fixed SnSe nanoflakes on the surface of reduced graphene oxide. It was found that the reduced graphene-oxide and a SnSe/graphene-oxide nanohybrid show a broader reverse saturable absorption and an enhanced non-linear optical response [3]. He *et al.* demonstrated a passively mode-locked all polarization maintaining Er^{3+}-doped fiber laser based on a non-linear amplifying loop mirror. A stable optical frequency comb with tunable wavelength is realized successfully. By adjusting the pump power, the central wavelength can be changed from 950 to 1,080 nm and from 1,650 to 2080 nm [4]. Chen *et al.* successfully stripped $NbSe_2$ thin layer by mechanical exfoliation and deposited $NbSe_2$ thin layer on D-type fiber as SAs. A stable dissipative soliton with a pulse duration of 174 ps is produced by coupling saturable absorber into Yb^{3+}-doped fiber laser [5]. Wei *et al.* summarized the structural, photoelectric and saturable absorption properties of two-dimensional materials. The working principle of wavelength tunable single-frequency fiber laser based on two-dimensional material have been discussed. On this basis, the latest research progress of wavelength tunable single-frequency fiber lasers and the future development prospect of this field is reviewed [6]. Zhang *et al.*

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proposed a novel porous-core photonic crystal fiber based on Thermoplastic Olefin Polymer of Amorphous Structure (TOPAS). The core shapes of core and cladding are asymmetric rectangular air holes and six-ring hexagonal lattice circular air holes respectively. The photonic crystal fiber can realize low loss terahertz polarization transmission in a wide frequency range [7].

The seven selected articles in this issue cover only part of the latest developments and applications in the field of low-dimensional materials in ultrafast photonics. From the current development, low-dimensional materials can not only be used as SAs to improve the performance of lasers, but also as nano hybrid materials to further improve the nonlinear response. In the future, we sincerely hope that the low-dimensional materials used in ultrafast photonics will make great progress.

AUTHOR CONTRIBUTIONS

LX put forward the writing outline of the editorial, collected and sorted out the cited literature, and made important amendments to the paper. SZ is responsible for drafting the paper. ZH, SY, and PK revised the paper and approved the final version.

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