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Introduction to two-dimensional layered materials for ultrafast lasers

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We introduce the background and motivation of this feature issue of two-dimensional layered materials for ultrafast lasers. A brief summary of the seven collected articles in this feature issue is also given.

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Welcome to the Photonics Research Feature Issue on **Two-Dimensional Layered Materials for Ultrafast Lasers.**

Two-dimensional (2D) layered materials have attracted considerable interest for photonics and optoelectronics applications, due to their unique structure and strong light-matter interaction. Indeed, 2D materials have been widely investigated for fundamental physics as well as applied science. In particular, there is a great potential for 2D materials based optical modulators and ultrafast photonics. The intent of this special issue is to provide a general overview of new advances in the selected fields of 2D materials photonics from perspective features to applications.

This issue combines 7 invited articles on 2D materials based ultrafast lasers and all-optical modulators. The first article investigates the saturable absorption (SA) properties of different Bi_2Se_3 samples with micro P-scan method [1]. Influence of the second surface state and thickness on the SA is studied. Conclusively, the SA properties can be tuned by changing the excitation wavelength and the sample thickness. The second article reports WSe_2 and $MoSe_2$ based SA devices with enhanced modulation depth up to 31.25% [2]. Then the authors have used the devices to demonstrate passively *Q*-switched lasers with high signal-to-noise ratio (up to 72 dB). The third article is from South China Normal University (China) [3]. This contribution reports an all-fiber broadband resonator by depositing graphene onto a microfiber knot, with which high-repetition Er-doped and Yb-doped fiber lasers have been demonstrated. Such a broadband microfiber knot resonator can be applied to achieve high repetition ultrafast lasers for various applications (e.g., optical frequency comb generation). The fourth article is a review paper from Ciyuan Qiu's group at Shanghai Jiao Tong University, China [4]. This article reviews the recent work on thermo-optic all-optical devices based on 2D materials. Various thermo-optic mechanisms have been discussed. The fifth article is from Jun Han Li's group at University of Seoul, South Korea [5]. For the first time, this article demonstrates a $CoSb_3$ skutterudite based femtosecond fiber laser with pulse width of ~833 fs and spectral width of ~3.4 nm. The sixth article demonstrates a novel 2D TiS_2 nanomaterial with strong SA [6]. With this 2D nanomaterial deposited on the fiber end facet, *Q*-switched and mode-locked lasers have been achieved. This contribution highlights the potential of TiS_2 nanomaterials for ultrafast pulse generation. The seventh article is from Zhengqian Luo's group at Xiamen University, China [7]. This article demonstrates a single-longitudinal-mode Er-doped fiber laser passively *Q*-switched by a few-layer Bi_2Se_3 saturable absorber. Stable single-frequency pulses with a linewidth of 212 kHz have been generated.

These collected articles in this special issue cover the novel 2D materials based ultrafast lasers and all optical modulators. We hope you will find this Photonics Research Feature Issue to be an interesting and useful reference that will stimulate your further research and applications in this exciting field.

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