2019

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Advances in Condensed Matter Physics
Volume 2019, Article ID 8365870, 2 pages
https://doi.org/10.1155/2019/8365870

Editorial

Two-Dimensional Material and Metasurface Based Optoelectronics

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Received 2 January 2019; Accepted 3 January 2019; Published 12 February 2019

Two-dimensional (2D) materials have been intensively studied in the last decade due to their extraordinary electronic and optical properties and have been shown to be greatly effective in optoelectronic applications. In the mean times, metasurfaces, as a two-dimensional form of metamaterials, have presented exceptional abilities for controlling the flow of light. The unique and novel characteristics of both 2D materials and the metasurfaces strongly promoted the development of photonics, electronics, optoelectronics, device physics, optical communication, and so on. As a matter of course, the combination of 2D materials and metasurface became a future research direction in optoelectronics. The purpose of this special issue is to present some recent progress on two-dimensional (2D) material and metasurface based optoelectronics. A brief summary of all accepted papers is provided below.

In the paper by B. Liu et al., they have reviewed the two-dimensional optical metasurfaces from plasmons to dielectrics. The review includes the progress in developing optical metasurfaces over the past few years and looks into the near future.

The paper posted by G. Jiang et al. fabricates a PMMA sandwiched Bi2Te3 self-assembly layer as a saturable absorber device, which was used as a passive mode locker for ultrafast pulse generation at the telecommunication band. Based on it, they have demonstrated a stable mode-locked fiber laser. The results indicate that PMMA sandwiched topological insulator layer structure could be an improvement technology in traditional PMMA transfer method and could be used as a long-term stable saturable absorber for the passively mode locking lasers.

The work reported by L. Chen et al. proposes a reverse modulation fiber-wireless system with two jointed DSP algorithms: the discrete Fourier transform spread (DFT-Spread) and the averaging of the channel frequency response (H-averaging) technology for improving the transmission performance of 22Gbit/s 16QAM-OFDM reverse modulation system at 60GHz by more than 15km fiber transmission under the soft decision forward error correction (SD-FEC) threshold 3.8×10^{-3}.

The paper by X. Yin et al. proposes a method for rubber identification based on terahertz time-domain spectroscopy (THz-TDS) and support vector machine (SVM). The method proposed in this paper can identify three types of rubber quickly and nondestructively, which lays a theoretical foundation for the application of terahertz spectroscopy in rubber classification and identification and provides a new approach for the nondestructive identification of other rubber.

The paper by M. Wu and Y. Li demonstrates an all-fiberized passively Q-switched erbium-doped fiber laser (EDFL) via evanescent field interaction between molybdenum ditelluride saturable absorber (SA) and guided mode of the D-shaped fiber. With the help of the strong interaction between evanescent field and the nonlinear optical material, the all-fiberized Q-switched fiber laser can be realized, and the high energy pulsed fiber laser can be delivered.

The paper by Y. Chen et al. numerically studies the spatial characteristics of the optical parametric chirped-pulse amplification (OPCPA) process when the initial pump beam was aberrated. The walk-off effect was found to worsen the signal beam quality in the OPCPA system when the pump beam exhibited phase modulation. However, as the pump intensity was modulated, the walk-off effect filtered out some aberrations; the signal beam quality improved but at the cost of reduced gain.

The paper by C. Tan et al. displays the theoretical and experimental study of all-optical switching for signal lasers based on the plasma channel induced by the control laser. Using the plasma channel generated in the carbon disulfide (CS2) solution, the signal light can be modulated as some spatial distributions, which provide great potential of the plasma channel induced by lasers as an all-optical switching for various optoelectronic applications.

The paper by Y. Chen et al. provides a scheme to realize a thermo-tunable and less loss isotropic negative-index metamaterials up to terahertz regime by embedding the dielectric spheres in a semiconductor host medium randomly. Such reconfigurable and thermotunable metamaterials have a very promising future for designing tunable devices such as tunable optical cloaking, tunable spatial light modulators, and tunable novel microwave antenna.

The paper by Y. Ye et al. theoretically investigates the optical tristability with low threshold by constructing a simple double layer graphene structure. By tuning the dispersion parameters of grapheme, hysteretic response characteristic optical tristability can be flexibly manipulated.

The paper by Q. Tan et al. numerically investigates the coupled effects of blood vessels and thermal relaxation time on temperature and thermal lesion region in biological tissue during high-intensity focused ultrasound (HIFU) hyperthermia. It also modifies the traditional Pennes bioheat equation to thermal wave model of bioheat transfer (TWMBT) and presents a joint physical model, which combines TWMBT for tissue and energy transport equation for blood vessel.

The paper by X. Guo et al. proposes a switching multiple input and multiple output (MIMO) system combining with adaptive orthogonal frequency division multiplexing (OFDM) modulation for high-speed indoor visible light communications. Experimental results confirm that data rates are improved significantly under the condition of different channel correlations and different locations of transmitters and receivers, where BERs are all below the 7% preforward error correction (pre-FEC) threshold of 3.8×10^{-3}.

The paper by J. Tang et al. proposes a novel structure consisting of graphene and optical lattice which can realize the enhancement of reflected group delay and switch between positive reflected group delay and negative reflected group delay of optical pulse, making the graphene-PC structure a good candidate for dynamic tunable optical delay device in the THz frequencies.

The paper by H. Zhou et al. reports a radio-over-fiber (ROF) access network with multiple high-repetitive frequency mm-wave signal generation utilizing a dual-parallel Mach-Zehnder modulator (DP-MZM) and a semiconductor optical amplifier (SOA) for multiple base stations (BSs). This scheme can raise the capacity of ROF system, reduce the requirement of the repetitive frequency of the driven RF signal, and support multiple mm-wave wireless access for BSs.

The paper by S. Wang et al. numerically demonstrates the tunable terahertz absorption in the interface between graphene and dielectric Bragg reflector (DBR). It has been found that the different wavelength absorption effect can be altered by adjusting the dielectric constant, thickness of the top layer, or the Fermi energy of grapheme, and the near perfect absorption can be achieved at different frequency bands in the structure.

The paper by X. Guo et al. proposes and experimentally demonstrates a novel Zadoff-Chu matrix (ZCM) precoding scheme, which can not only reduce the PAPR but also provide uniform signal-to-noise ratio (SNR) profile. The results show that the PAPR of the ZCM precoding scheme is much lower than the existing Walsh-Hadamard matrix and the OCT precoding schemes.

The paper by X. Guo et al. investigates the performance of the 32-quadrature amplitude modulation (32-QAM) constellation shaping schemes for the first time, where two special circular constellations, named Circular (4, 11, 17) and Circular (1, 5, 11, 15), and a triangular constellation are proposed based on the Shannon's criterion, and shows that both circular constellations achieve a better tradeoff between noise resistance and nonlinearity resistance, leading to a better BER performance.

We would like to express our thanks to all authors who made this special issue possible. We hope this collection of articles will be useful to the optoelectronics science community and inspire further research in two-dimensional material and metasurface directions.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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