Hindawi
Advances in Condensed Matter Physics
Volume 2018, Article ID 7176029, 2 pages
https://doi.org/10.1155/2018/7176029

Editorial

Photonics and Optoelectronics of Low-Dimensional Materials

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Received 3 April 2018; Accepted 3 April 2018; Published 3 June 2018

Recently, the study of low-dimensional materials has gained significant interest for a variety of photonic and optoelectronic applications. Low-dimensional materials exist in a kind of systems in which electronic state wavefunction is confined, at least in one of the three dimensions. Decreasing the dimensionality of the materials to the nanoscale in one, two, or three directions leads to thin film structures (2D), wires (1D), or dots (0D), respectively. Thus the low materials possessing quantum size effects have significantly changed their electronic properties and deeply modified their photonic and optoelectronic performances when compared with their bulk form. Due to their varied electronic and optical properties, low materials have been utilized for a wide range of applications, such as transistors, nonlinear optics, ultrafast optics, electrooptic modulator, photovoltaics, plasmonics, and photodetectors. The importance to these device applications is an enhanced understanding of fundamental structural, electronic, optical, quantum simulations, thermal, and luminescent properties. In this special issue, several authors have been invited to submit original research articles that will motivate the continuing efforts to study the basic physical properties of low-dimensional materials.

Photonic composite containing both Yb^{3+}, Er^{3+} codoped Ba_2LaF_7 and Ag nanocrystals has been fabricated through the melt-quenching and heating treatment method. Due to the surface plasmon resonance of Ag nanoparticles, spontaneous upconversion and stimulated emissions from Yb^{3+}, Er^{3+} ions have been efficiently enhanced in Ba_2LaF_7 nanocrystals. The result suggests an effective way to improve the luminescent performance for upconversion materials. Based on the effective-mass approximation and variational procedure, the external electric field effect on shallow-donor impurity states has been investigated in zinc-blende $In_xGa_{1-x}N/GaN$ symmetric coupled quantum dots. The donor binding energy is studied as a function of the dot thickness, the dot radius, the external electric field, and the impurity position.

Temperature dependence of the energy band diagram of AlGaN/GaN heterostructure has been studied by D. Chen et al. through theoretical calculation and experiment. Their work offers important theoretical and experimental basis for the performance degradation of AlGaN/GaN high electron mobility transistors with increasing temperature. Based on first-principles calculations, the atomic and electronic properties of Ge/4H-SiC heterojunction have been investigated by L. Li et al. Considering the importance in silicon photonics, S. Feng et al. have studied a micro-nano Si/SiGe/Si double heterojunction electron-optic modulation structure. Based on the density functional theory, the structural and optical properties of α-quartz cluster with oxygen-deficiency centers defects have been studied by R. Zhang et al.

Z. Wu et al. have reported the structural and transport properties of wafer-scale 2D layered materials fabricated by pulsed laser deposition method. Based on the deposited uniform 2D few-layer MoS_2, back-gated field effect transistors have been developed. The growth parameters have important effects on the photonic and electronic properties of the thin films. The effects of deposition temperature on structural, optical properties and laser damage of $LaTiO_3$ thin films

have been studied by C. Yang et al. Organic polymer-based photovoltaic systems provide a practicable alternate to more standard solid-state devices for solar-harvesting applications. A. Kelley et al. have investigated roles of delocalization and local packing based on quantum simulations of charge-separation at a model donor-acceptor interface.

It is believed that the publication of this special issue will be of reference value for readers working in the areas related to low-dimensional materials for photonic and opto-electronic applications.

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