Front. Phys. Vol. 17, No. 4 (2022)
https://journal.hep.com.cn/fop

Nanophotonics and Spectroscopy Research Group, School of Mathematics and Physics, University of Science and Technology Beijing

Location

School of Mathematics and Physics,
University of Science and Technology Beijing,
Beijing 100083, China

Overview

Established in 2010, the research of the college covers major fields related to physics such as condensed matter physics, theoretical physics, optics, atomic and molecular physics. A material analysis platform including spherical aberration corrected Transmission Electron Microscope, 200 kV FEG Transmission Electron Microscope, field emission scanning electron microscope, X-ray diffractometer, vibrating sample magnetometer, and high-performance computing cluster has been built.

Key Contact

Professor Mengtao Sun
Leader of Nanophotonics and Spectroscopy Research Group
E-mail: mengtaosun@ustb.edu.cn

Research Foci

- **Surface-enhanced spectroscopy:** Surface enhancement spectroscopy is based on the basic theory of surface plasmonics photonics, using the local electromagnetic field enhancement characteristics of metal nanostructures to enhance optical signals such as fluorescence or Raman spectroscopy. Enhanced fluorescence and Raman spectroscopy are widely used in highly sensitive biochemical sensing, new light sources, high-efficiency optical components, and nano-optical imaging due to their advantages of high sensitivity and diverse methods.
- **Plasmonics:** The intensity, propagation direction, polarization and other properties of light can be manipulated at the nanoscale by surface plasmon resonance of metal nanostructures. Main researches include the phenomenon, principle and application of the nanostructure system based on surface plasmon resonance.
- **Physical properties of 2D materials:** Mainly research the optical and electrical properties caused by the particularity of different two-dimensional materials, including Raman spectroscopy, photoluminescence spectroscopy, absorption spectroscopy, thermal properties, electrical transport properties, which are used in optoelectronic devices, thermoelectric devices, optical detection, etc.

Recent Research

The interfacial charge transfer exciton enhanced by plasmon in 2D in-plane lateral and van der Waals MoS_2/WS_2 heterostructures has been studied, which promote a deeper understanding of the plexciton resulting from strong coupling between the plasma and exciton of lateral and van der Waals heterostructures [1, 2].

A multimer coupling classic harmonic oscillator model has been presented

to reveal the scattering and photoluminescence (PL) properties of metallic nanoparticle chains. This work would be helpful to understanding the optical properties more deeply and gives a unified treatment for scattering and PL properties of strongly coupled multimer system. It is also useful for related applications utilizing strongly coupled system of nanophotonics [3].

The physical mechanism of bilayer (BL) borophene synthesized on Ag (111) film has been investigated. BL borophene demonstrates excellent optical and thermoelectric performance, which provides a prototype for the design of borophene-based optical sensors and thermoelectric devices [4].

The nonlinear optical properties of a D–A (donor–acceptor) conjugated organic molecule with polythiophene (PT) as the donor and indene-C_{60} bisadduct ($IC_{60}BA$) as the acceptor are theoretically investigated, which provides a feasible method to improve the nonlinear properties of organic solar cell materials [5].

References

1. X. Mu and M. Sun, Interfacial charge transfer exciton enhanced by plasmon in 2D in-plane lateral and van der Waals heterostructures, *Appl. Phys. Lett.* 117(9), 091601 (2020)
2. Y. Cao and M. Sun, Perspective on plexciton based on transition metal dichalcogenides, *Appl. Phys. Lett.* 120, 240501 (2022)
3. Y. Cheng and M. Sun, Unified treatment for photoluminescence and scattering of coupled metallic nanostructures (I): Two-body system, *New J. Phys.* 24(3), 033026 (2022)
4. R. Yang and M. Sun, Bilayer borophene synthesized on Ag(111) film: Physical mechanism and applications for optical sensor and thermoelectric devices, *Mater. Today Phys.* 23, 100652 (2022)
5. Y. Chen, Y. Cheng, and M. Sun, Nonlinear plexcitons: Excitons coupled with plasmons in two-photon absorption, *Nanoscale* 14(19), 7269 (2022)