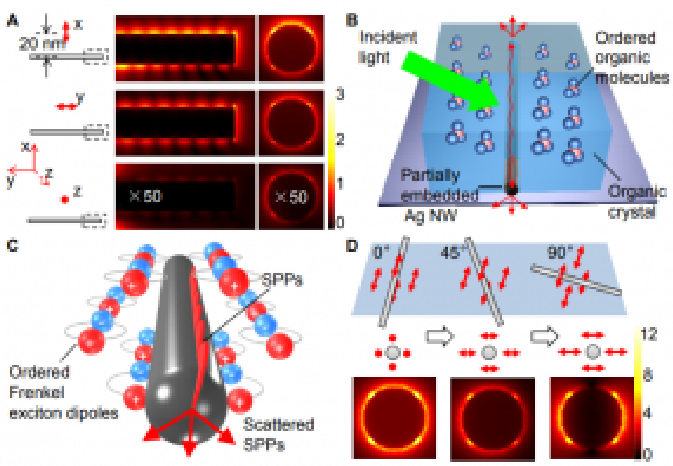
Orientation-Dependent Exciton-Plasmon Coupling in Embedded Organic/Metal Nanowire Heterostructures



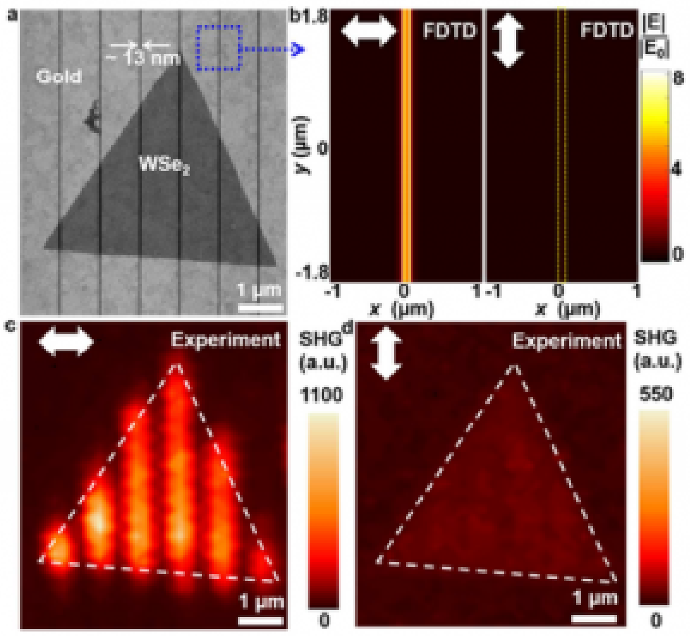
Organic/metal nanowire heterostructures for the study of orientation dependent exciton-plasmon coupling. (A) Numerically simulated |E| 2 distribution of SPPs at the end of a 200-nm-diameter and 6 μm-long AgNW, where SPPs are launched by a dipole oriented along three coordinate axes x, y, and z, respectively. The dipole is positioned at the middle of the wire with a distance of 20 nm. (B) Schematic illustration for the proposed heterostructure with orderly arranged molecules around a partially embedded AgNW. (C) Oriented Frenkel typeexciton dipoles created around the AgNW by irradiation of an incident light at the junction. SPPs can be efficiently launched by the exciton dipoles, which will subsequently propagate along the AgNW and scatter into free space at the distal ends. (D) SPPs coupling by multiple exciton dipoles. The cross angle between the AgNW and the polarization of dipoles are 0°, 45° and 90°.

The excitation of surface plasmons by optical emitters based on exciton-plasmon coupling is important for plasmonic devices with active optical properties. It has been theoretically demonstrated that the orientation of exciton dipole can significantly influence the coupling strength, yet systematic study of the coupling process in nanostructures is still hindered by the lack of proper material systems. In this work, researchers have experimentally investigated the orientation-dependent exciton-plasmon coupling in a rationally designed organic/metal nanowire heterostructure system. The heterostructures were prepared by inserting silver nanowires into crystalline organic waveguides during the self-assembly of dye molecules. Structures with different exciton orientations exhibited varying coupling efficiencies. The near-field exciton-plasmon coupling facilitates the design of nanophotonic devices based on the directional surface plasmon polariton propagations.

this research has published as a paper.

more information:https://www.ncbi.nlm.nih.gov/pubmed/28930431

Selectively Plasmon-Enhanced Second-Harmonic Generation from Monolayer Tungsten Diselenide on Flexible Substrates



. Pump-laser-polarization dependent SHG mapping. (a) SEM image of single-crystalline monolayer WSe2 flake on trenches with a pitch of 910 nm. (b) Simulated electric field distribution at a plane 1 nm above the surface of gold substrate with pump laser polarized perpendicular (left panel) and parallel (right panel) to the trench. The dotted line outlines the geometry of the trench. (c,d) Corresponding experimental SHG mappings of the exact WSe2 flake on trenches as shown in the SEM image in (a) under resonant and non-resonant excitations, respectively. White dashed lines outline the WSe2 flake. The white arrows show the polarization directions of the pump laser.

Monolayer two-dimensional transition metal dichalcogenides (2D TMDCs) exhibit promising characteristics in miniaturized nonlinear optical frequency converters, due to their inversion asymmetry and large second-order nonlinear susceptibility. However, these materials usually have a very short light interaction lengths with the pump laser because they are atomically thin, such that second-harmonic generation (SHG) is generally inefficient. In this research, Joel.K.W.Yangs group fabricated a judiciously structured 150-nm-thick planar surface consisting of monolayer tungsten diselenide and sub-20-nm-wide gold trenches on flexible substrates, reporting ~7000-fold SHG enhancement without peak broadening or background in the spectra as compared to WSe2 on as-grown sapphire substrates. their proof-of-concept experiment yields effective second-order nonlinear susceptibility of 2.1 × 104 pm/V. Three orders of magnitude enhancement is maintained with pump wavelength ranging from 800 nm to 900 nm, breaking the limitation of narrow pump wavelength range for cavity-enhanced SHG. In addition, SHG amplitude can be dynamically controlled via selective excitation of the lateral gap plasmon by rotating the laser polarization. Such fully open, flat and ultrathin profile enables a great variety of functional samples with high SHG from one patterned silicon substrate, favoring scalable production of nonlinear converters. The surface accessibility also enables integration with other optical components for information processing in an ultrathin and flexible form.