

SUPPLEMENTAL INFORMATION

Plasmonic Gold Nanorods Coverage Influence on Enhancement of the Photoluminescence of Two-Dimensional Two- Dimensional MoS₂ Monolayer

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MoS₂ Nanosheet Coated with Gold Nanoparticles

To confirm the PL enhancement caused by the coupling between Au LSPR waves and the MoS₂ emission, we also prepare a reference MoS₂ nanosheet coated with the Au nanoparticles, which its LSPR wavelength deviates from the MoS₂ emission spectrum. The spherical Au nanoparticles with a diameter of 15 nm were placed on the top of the reference devices with the same coating procedure. The black curve in Figure S1(a) represents its absorption spectrum, and the LSPR peak was at a wavelength of approximately 556 nm, which is far from the emission peak of MoS₂ (the red curve in Figure S1(a)). The inset in Figure S1(a) is an SEM image of the Au nanoparticles on the MoS₂ surface. Figure S1(b) shows the measured PL spectra from the MoS₂ nanosheet with different Au nanoparticle densities, ranging from 0 to 335 μm^{-2} , and Figure S1(c) shows the PL peak intensity of the MoS₂ nanosheet with different nanoparticle densities. Because of the spectral mismatch of Au nanoparticle LSPR and MoS₂ emission, the PL peak (~670 nm) intensity of the MoS₂ with gold nanoparticles was degraded as the Au nanoparticle coverage increased. The behavior serves as evidence of the shielding effect because the excessive metallic objects absorbed MoS₂ emission.

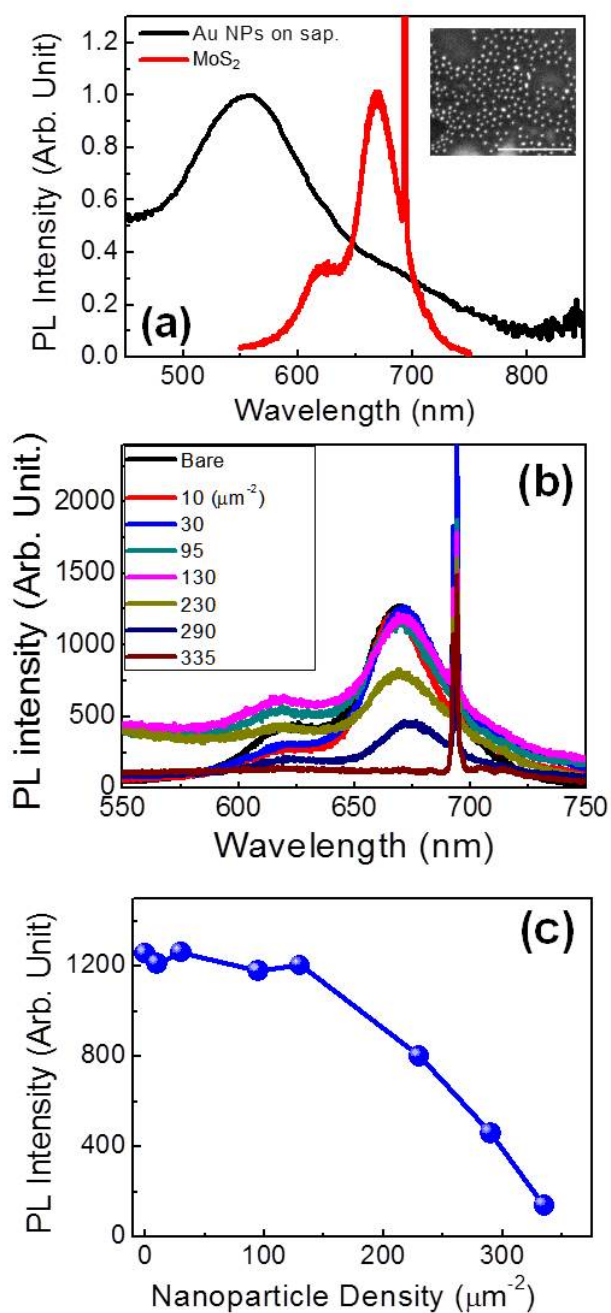


Figure S1 (a) The extinction spectra of the gold nanoparticles and PL spectra of the MoS₂ nanosheet. (b) PL spectra of gold nanoparticle-coated MoS₂ nanosheet with different area densities. The inset presents an SEM image of gold particles on the surface of the MoS₂. (c) PL intensity of the MoS₂ with the different densities of gold nanoparticles.

Raman Signal Enhancement of the MoS₂ Nanosheet with Gold Nanorods

The Raman signals of the MoS₂ under the different Au nanorod coverages were also characterized with the 488 nm wavelength pumping laser. Figure S2 shows the Raman spectra of MoS₂ with different nanorod densities. Two Raman peaks of the MoS₂ nanosheet were observed at 385 cm⁻¹ and 405 cm⁻¹. The intensity of Raman signals increased as the Au nanorod density increased. This behavior was attributed to the coupling between the pumping laser signal and the LSPR (~ 500 nm wavelength in the PL (black) spectrum of Figure 3(b)) along short-axis of nanorod. This surface-enhanced Raman spectroscopy (SERS) enhancement was not very high, compare to the reported values (10⁶ ~ 10¹⁴), due to the weaker LSPR waves along the short-axis of Au nanorod.

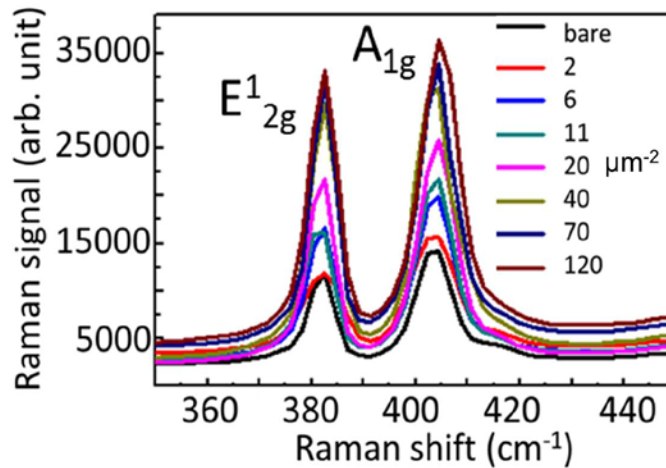


Figure S2 Raman spectra of the MoS₂ nanosheet with the different densities of Au nanorods.