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# Tailoring $MoS_2$ Optical Response: A Plasmonic Nanoparticle Approach

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Two-dimensional (2D) materials like $MoS_2$ hold immense promise for novel optoelectronic and nanophotonic applications. However, their practical implementation is often hindered by limited photoluminescence and Raman efficiencies. Plasmonic enhancement using metal nanoparticles provides an effective approach to overcome these limitations by enhancing light-matter interactions in these materials. In this work, we investigate the impact of plasmonic nanostructures, specifically silver (Ag) and gold (Au) nanoparticles of varying geometries, on the Raman and PL spectra of monolayer and few-layer $MoS_2$. Nanotriangles, nanorods, and nanospheres of Ag and Au are used to explore the effect of shape, size, and plasmonic properties on the enhancement factor.

Our findings reveal a significant enhancement in both Raman and PL intensities. Notably, nanotriangles and nanorods exhibit the most pronounced enhancement, attributed to the generation of intense plasmonic hot spots at their sharp edges and tips. The enhancement factors achieved for Raman and PL spectra were up to 6.8 times for silver nanotriangles and 4.3 times for gold nanorods, respectively. These enhancements are attributed to plasmonic coupling and the generation of hot spots that amplify the electric field in the vicinity of $MoS_2$ flakes. Additionally, the increased PL intensity is also linked to the injection of hot electrons from metal nanostructures, facilitating exciton generation and improving emission efficiency.

This study underscores the crucial role of nanoparticle geometry in optimizing plasmonic enhancement in 2D materials, providing valuable insights into the intricate physical mechanisms governing light-matter coupling within hybrid nanostructures. These findings are highly promising for the development of next-generation optoelectronic and photonic devices, including photodetectors, sensors, and other advanced technologies.

## Type of presence

Presence online

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