

## Supplementary information

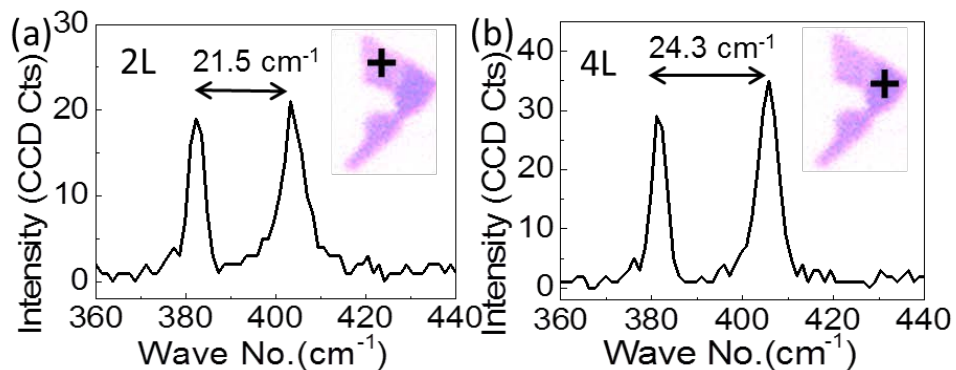
### Photoluminescence quenching in gold - MoS<sub>2</sub> hybrid nanoflakes

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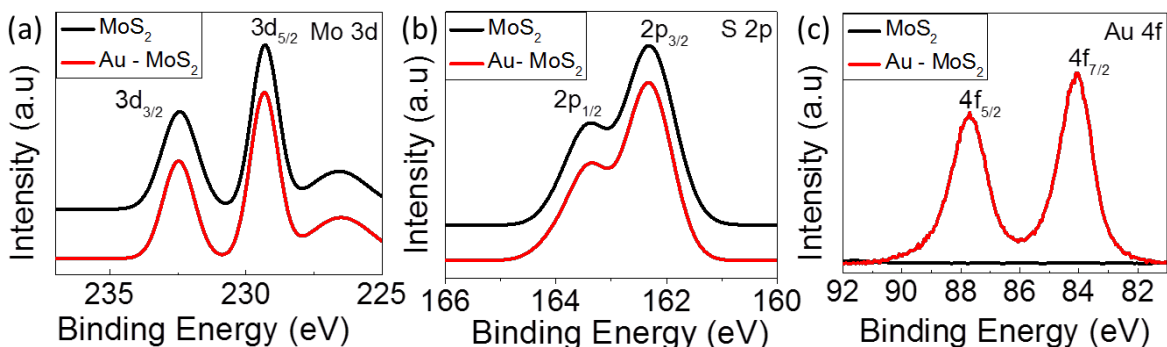
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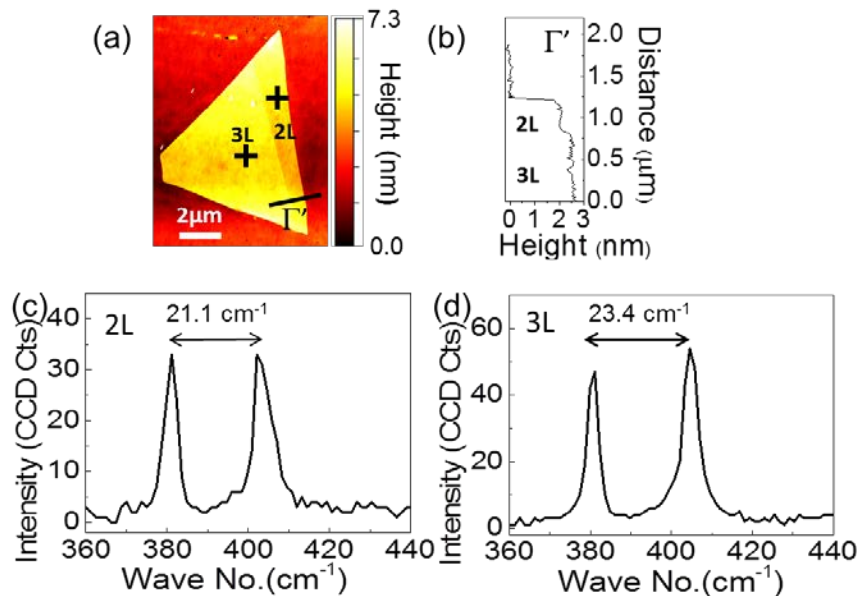
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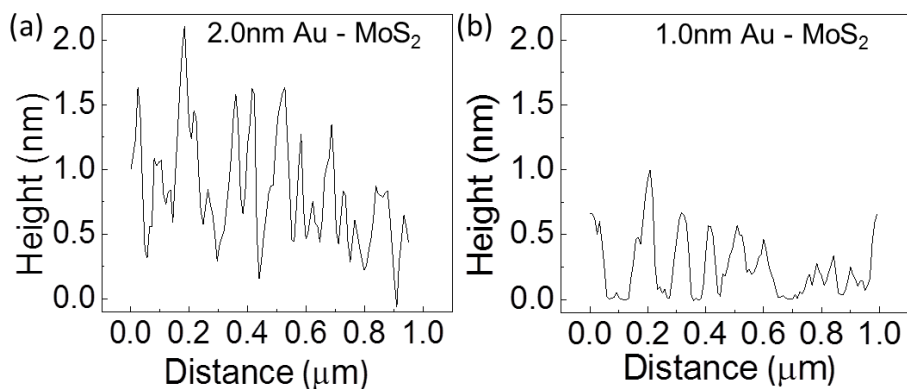
**Figure S1.** Raman Spectrum of the two layer (2L) and 4 layer (4L) of pristine MoS<sub>2</sub> flake. The difference between E<sub>2g</sub> and A<sub>1g</sub> peak is 21.5 and 24.3 cm<sup>-1</sup>, respectively. The difference in wave number measured corresponds to presence of 2L and 4L in the MoS<sub>2</sub> flake. Inset shows the optical micrograph of the MoS<sub>2</sub> flake with cross marks indicating the location for Raman spectrum acquisition.



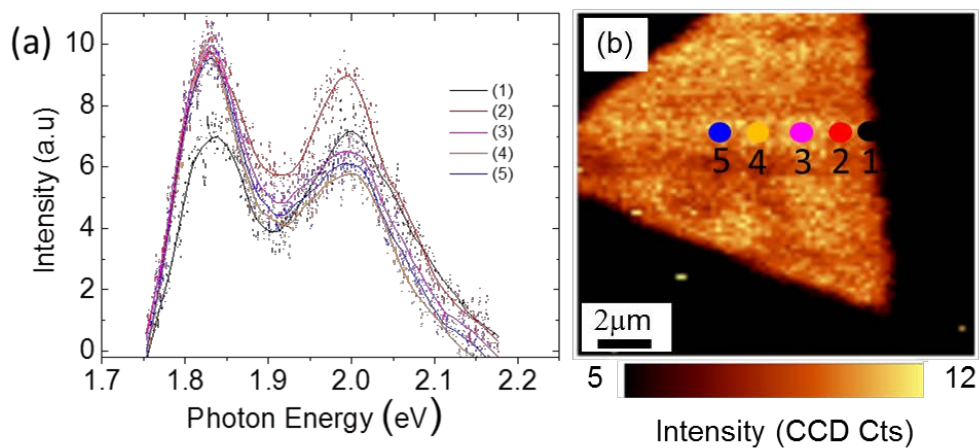
**Figure S2:** X-Ray Photoemission Spectroscopy (XPS) analysis of pristine MoS<sub>2</sub> (black curve) and Au-MoS<sub>2</sub> hybrid (red curve) for (a) Mo with Mo 3d binding energies peaks at 229.3 and 232.5 eV (b) S with S 2p binding energies peaks at 162.3 and 163.4 eV and (c) Au with Au 4f binding energies peaks at 84 and 87.8 eV. XPS data reveals that the position of Mo 3d and S 2p peaks does not change after Au deposition indicating that Au nanostructures do not change the crystal structure of MoS<sub>2</sub> flake.



**Figure S3:** (a) AFM image of the pristine MoS<sub>2</sub> flake used for 1 nm Au deposition study.  $\Gamma'$  line (black) indicates the position at which the height profile cross-section (b) was extracted to measure the height of the flake MoS<sub>2</sub> layers. (c,d) Raman spectra at location labeled '2L' and '3L' in (a). The difference between E<sub>2g</sub> and A<sub>1g</sub> peak were measured: 21.1 (c) and 23.4 cm<sup>-1</sup> (d), which is in agreement with the height for 2L and 3L region in the MoS<sub>2</sub> flake.



**Figure S4.** Height profiles used for Root mean square (RMS) analysis on MoS<sub>2</sub> flakes after 2.0 nm (a) and 1.0 nm (b) Au deposition on MoS<sub>2</sub>. Average heights of Au nanostructures were found to be 1.6 nm for 2.0 nm deposition (a) and 0.6 nm for 1.0 nm deposition (b).



**Figure S5.** (a) Local variation in the PL intensity of pristine MoS<sub>2</sub> flake used for 1 nm Au deposition study. Spectra were taken at five different points along a line as shown in the intensity map of A1 peak (b). (1) in black shows the signal acquired at 2L close to the edge of the nanoflake, while (2) in red shows the PL signature of 2L closer to the 3L interface. (3)-(5) are representative of the 3L MoS<sub>2</sub> PL signature.