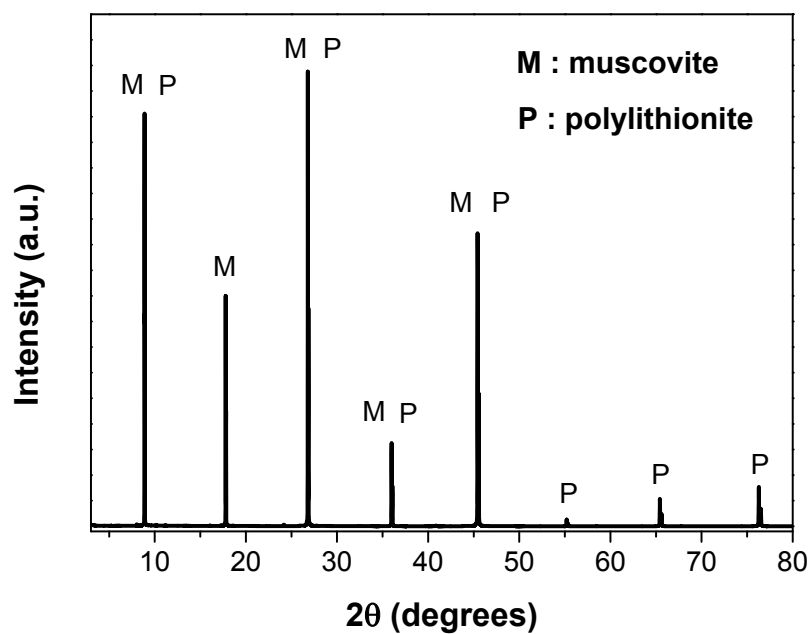


19 Supporting Information includes 7 pages, 11 figures.

20 Figures

21

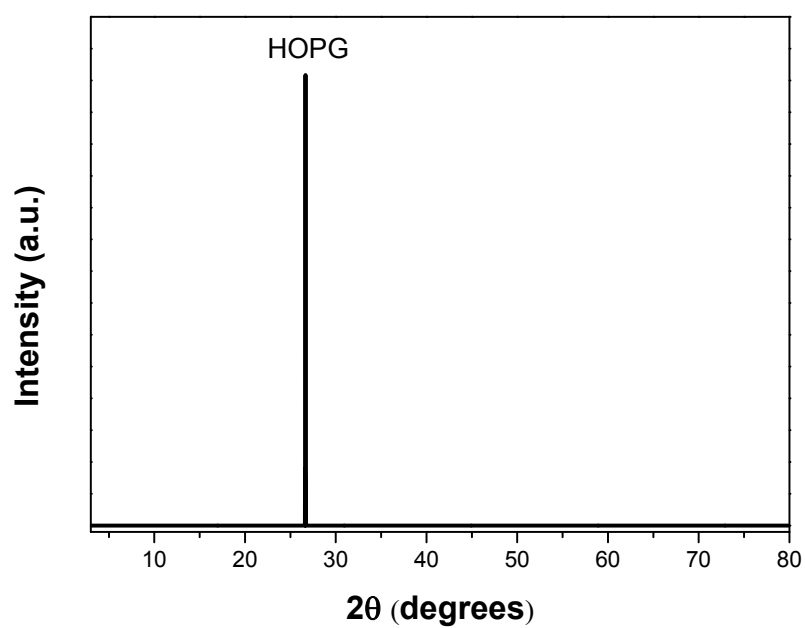
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Fig. S1. X-ray diffraction (XRD) pattern of natural mica.



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Fig. S2. X-ray diffraction (XRD) pattern of highly oriented pyrolytic graphite (HOPG).

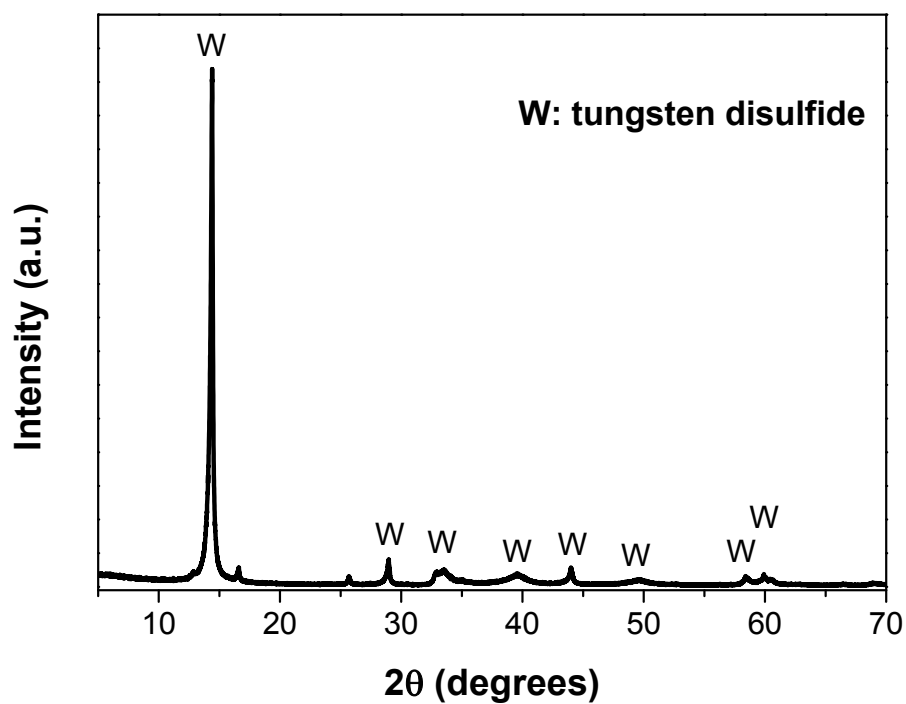


Fig. S3. X-ray diffraction (XRD) pattern of tungsten disulfide (WS_2).

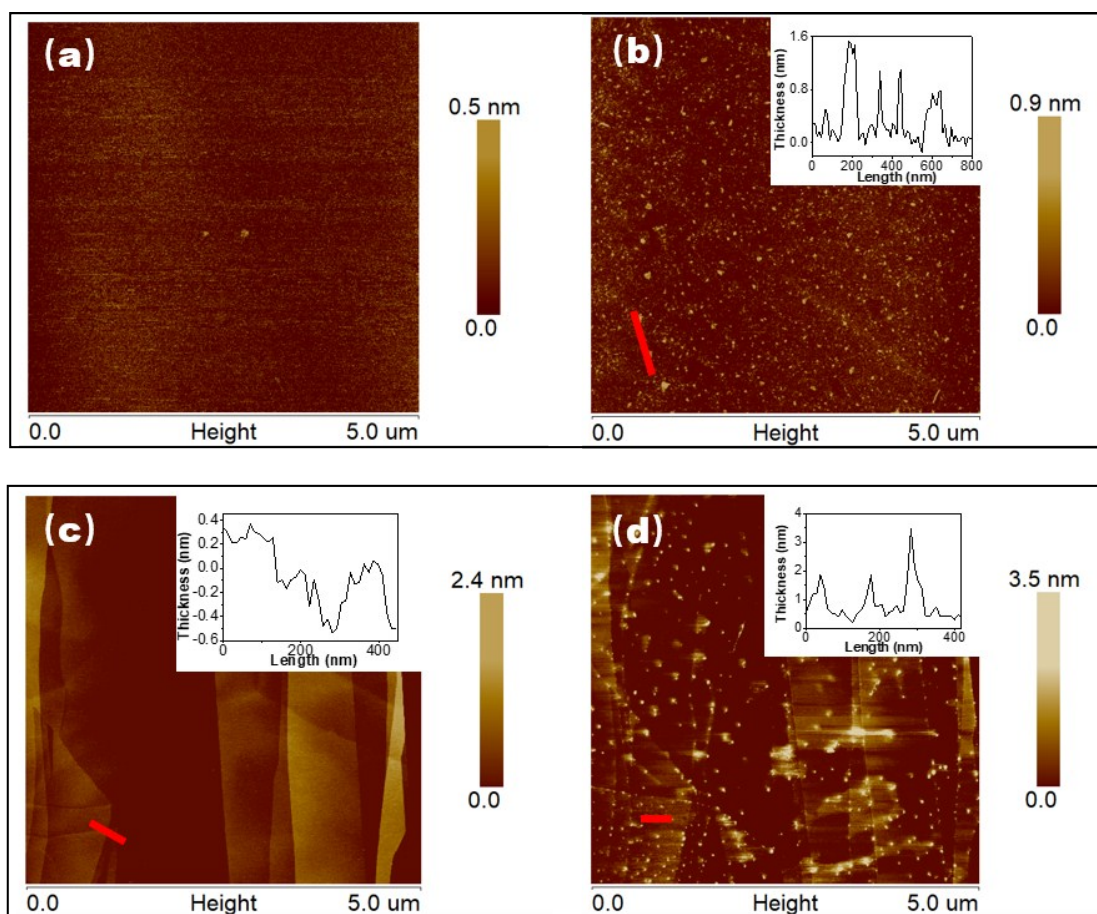


Fig. S4. AFM images of mica (a, b) and HOPG (c, d) surfaces before (left images) and after (right

images) HAuCl₄ solution loading. The experiments were carried out under AFM laser irradiation with wavelength of 670 nm.

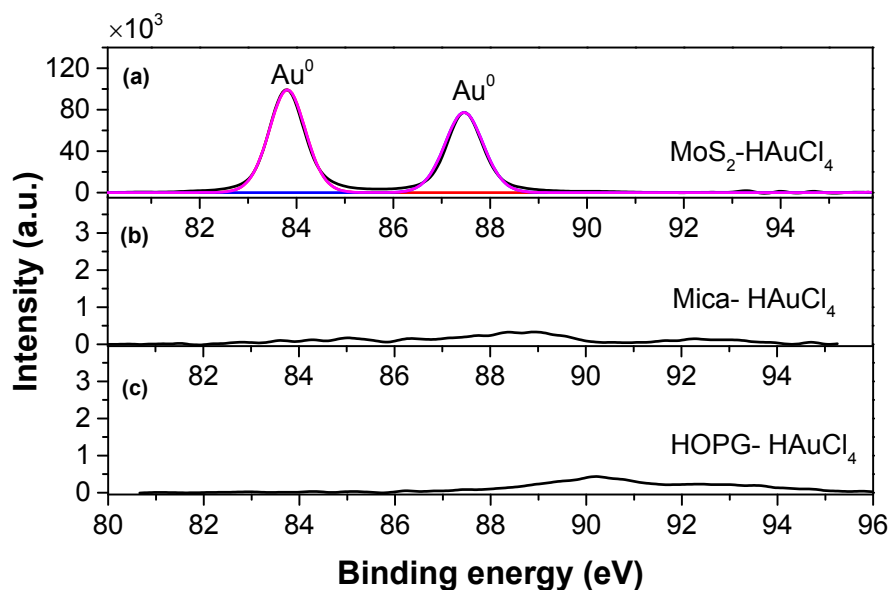


Fig. S5. X-ray photoelectron spectroscopy (XPS) spectra of molybdenum disulfide (a), mica (b), and HOPG (c) after 15 min HAuCl₄ loading under light irradiation with wavelength of 390-780 nm.

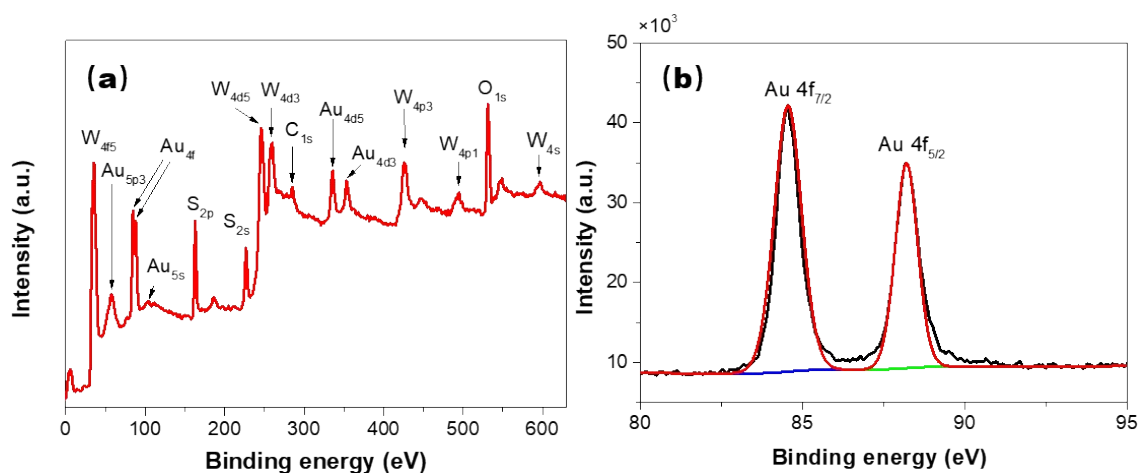


Fig. S6. XPS spectra of tungsten disulfide after reacting with HAuCl₄ for 24h under light irradiation with wavelength of 390-780 nm and light intensity of 150W: wide-scan XPS spectra (a), Au 4f spectra (b).

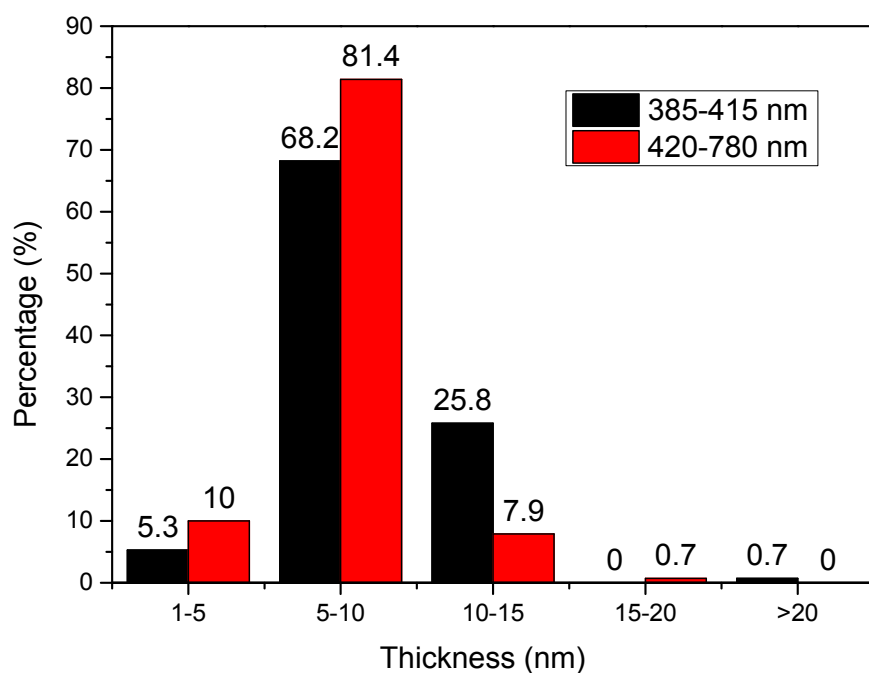


Fig. S7. Height distribution of Au particles on molybdenum disulfide after being exposed in HAuCl_4 solution and being irradiated at 385-415 nm and 420-780 nm wavelength.

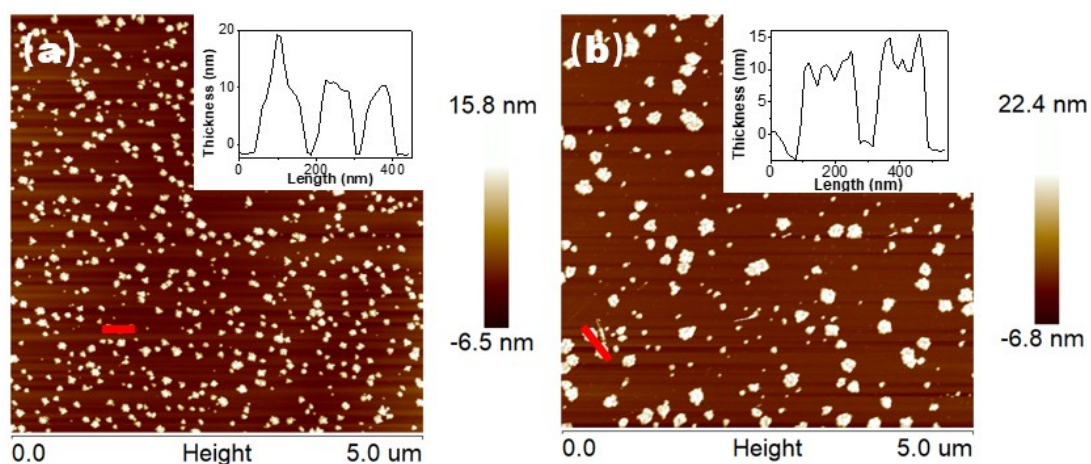


Fig. S8. AFM images of the MoS₂ after 15min HAuCl₄ at 5 °C (a) and 67 °C (b) under light irradiation with wavelength of 390-780 nm.

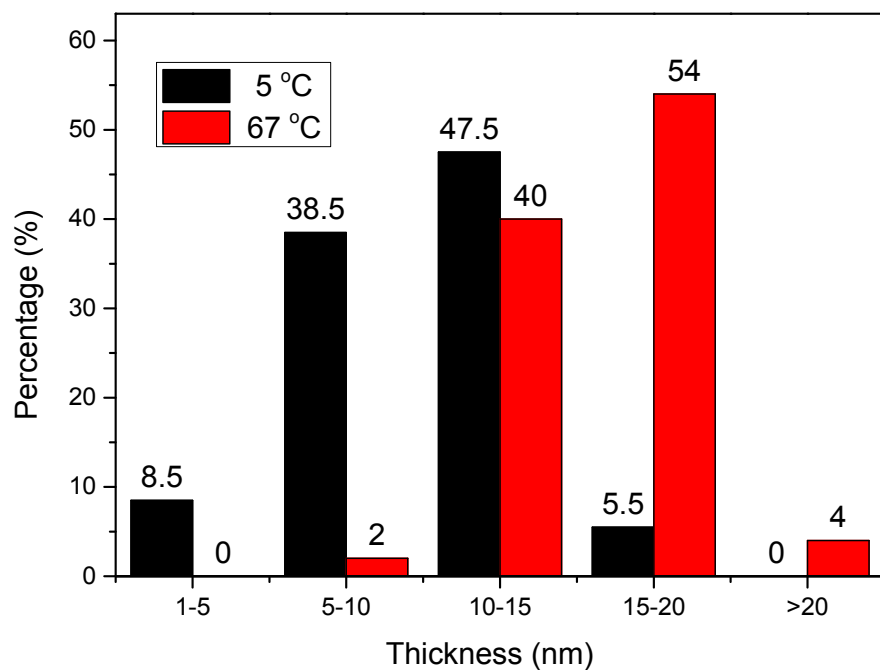


Fig. S9. Height distribution of the Au particles on MoS₂ after 15min HAuCl₄ at 5°C and 67°C under light irradiation with wavelength of 390-780 nm.

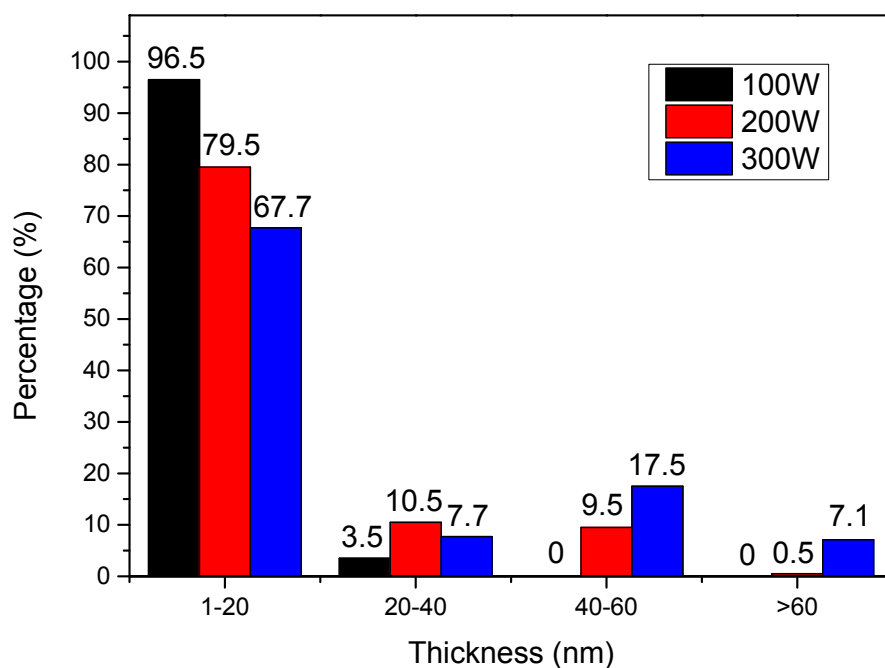
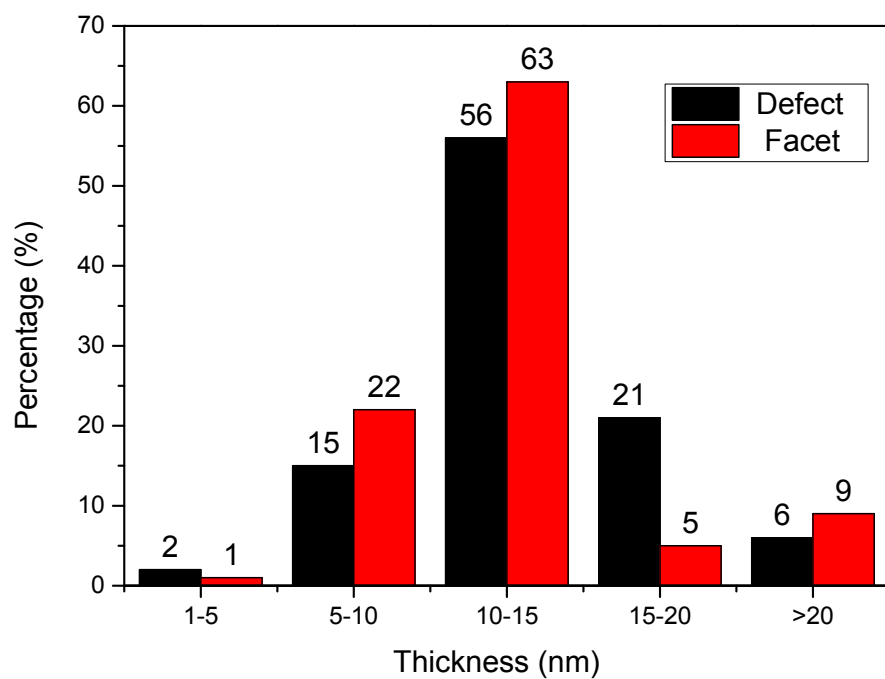


Fig. S10. Height distribution of Au particles on molybdenum disulfide after being exposed in HAuCl₄ solution under 420-780 nm irradiation with different light intensities: low light intensity (100W), medium light intensity (200W), and high light intensity (300W).



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65 **Fig. S11.** Height distribution of Au particles along defects and in flat area of MoS₂ surface after
 66 H₂AuCl₄ solution loading under 25°C.