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Supplementary Information

One-step selective formation of silver nanoparticles on atomic layered MoS_2 by laser-induced defect engineering and photoreduction

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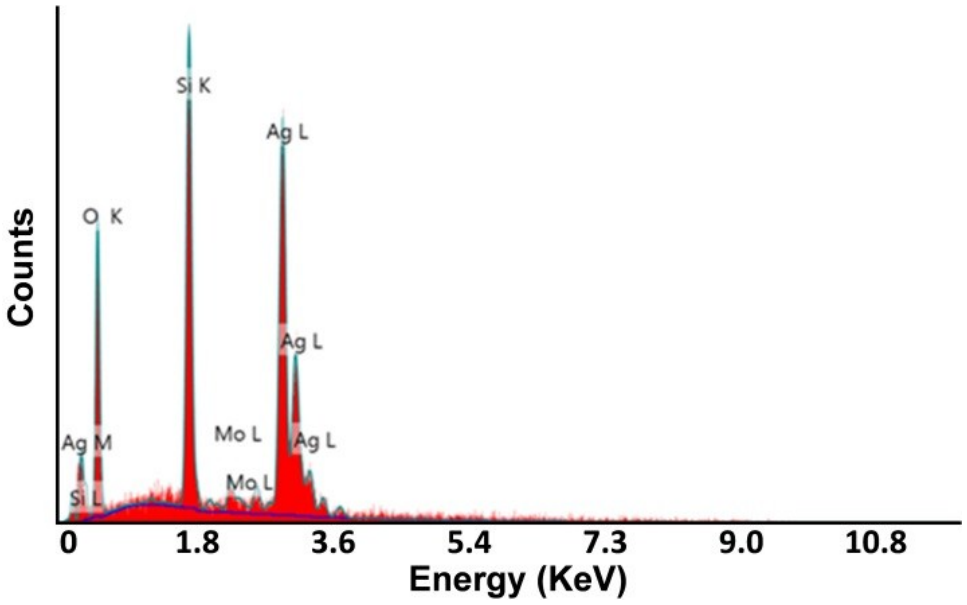

Fig. S1 Energy-dispersive X-ray spectrum of laser irradiated spot on MoS_2 immersed in $AgNO_3$ solution.

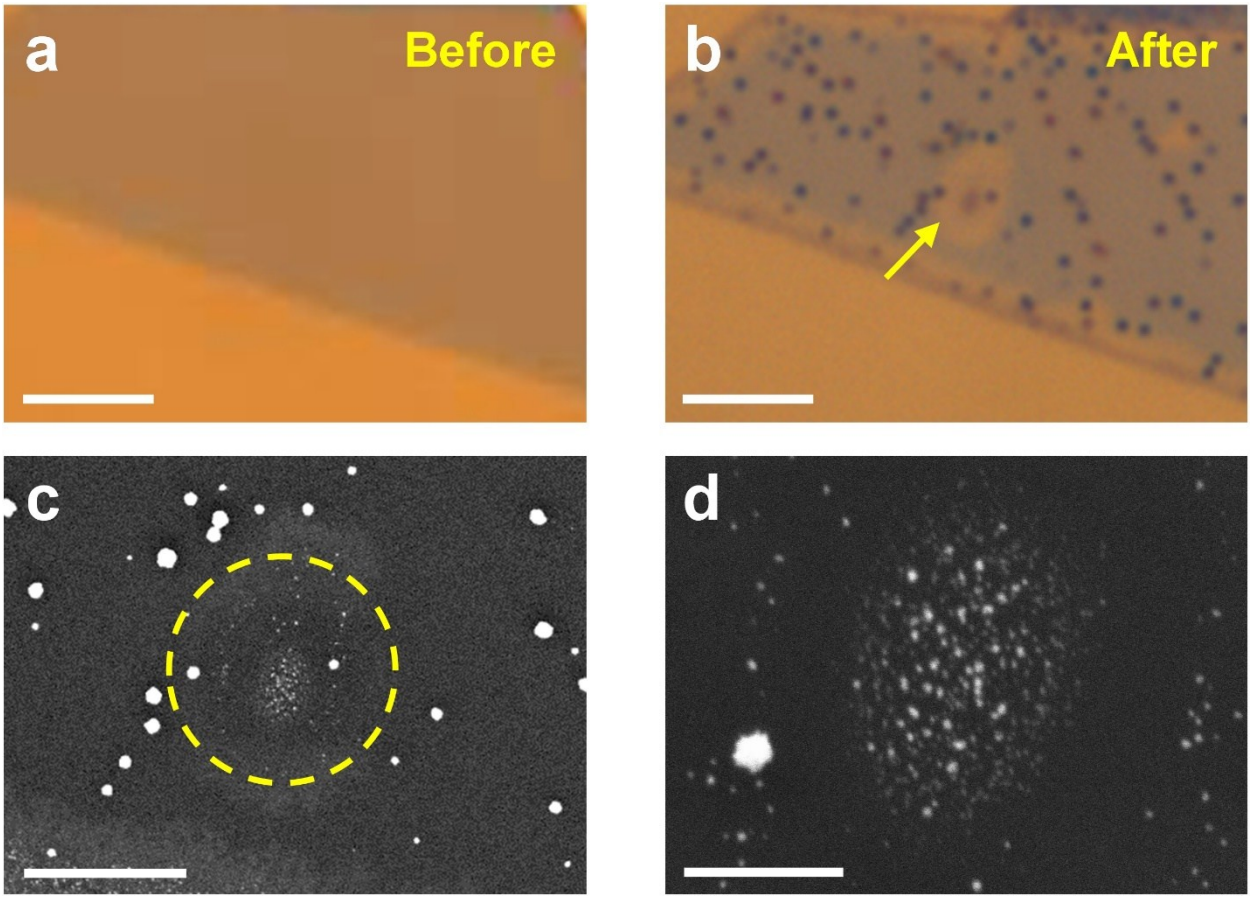

Fig. S2 Optical images of monolayer (1 L) MoS_2 flake immersed in 0.1 mM $HAuCl_4$ solution (a) before and (b) after irradiated with a focused 633 nm laser (50 μW) for 7 s. The yellow arrowed position in (b) was the laser focus spot. (c) Low and (d) high magnification SEM images of the yellow arrowed areas in (b). Scale bars: 10 μm in (a, b), 2 μm in (c) and 500 nm in (d).

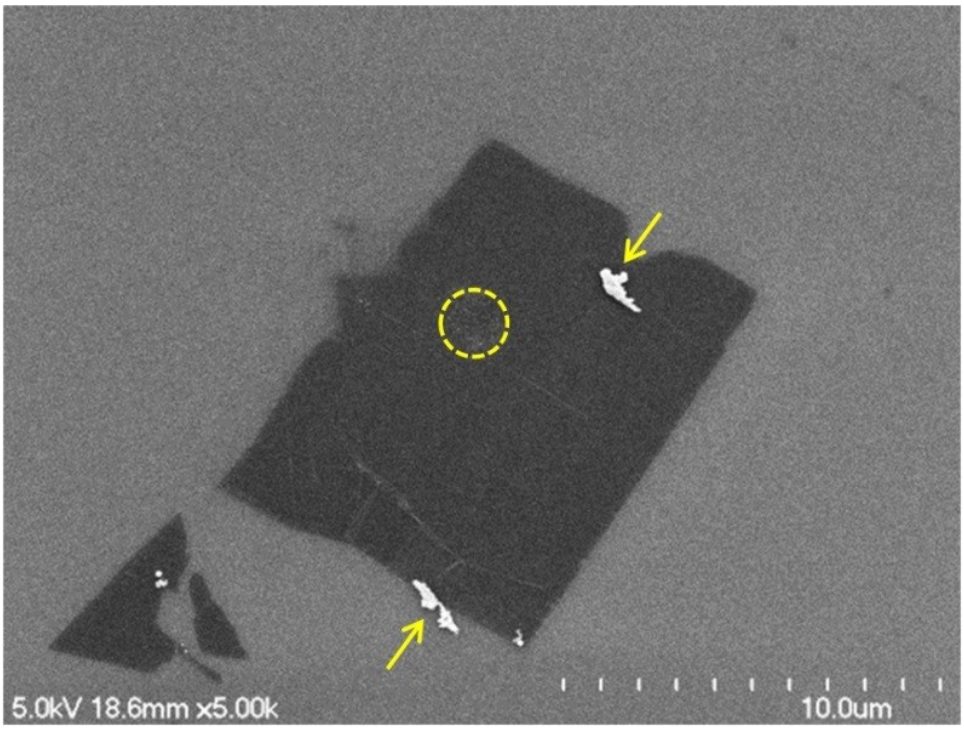

Fig. S3 SEM image of 1 L MoS_2 flake immersed in 1 mM $AgNO_3$ solution and irradiated with 633 nm laser (25 μW) for 7 s. The yellow dashed circle was the laser focus spot. The yellow arrowed spots were representative silver nanoparticles (NPs) formed during the sample focus process.

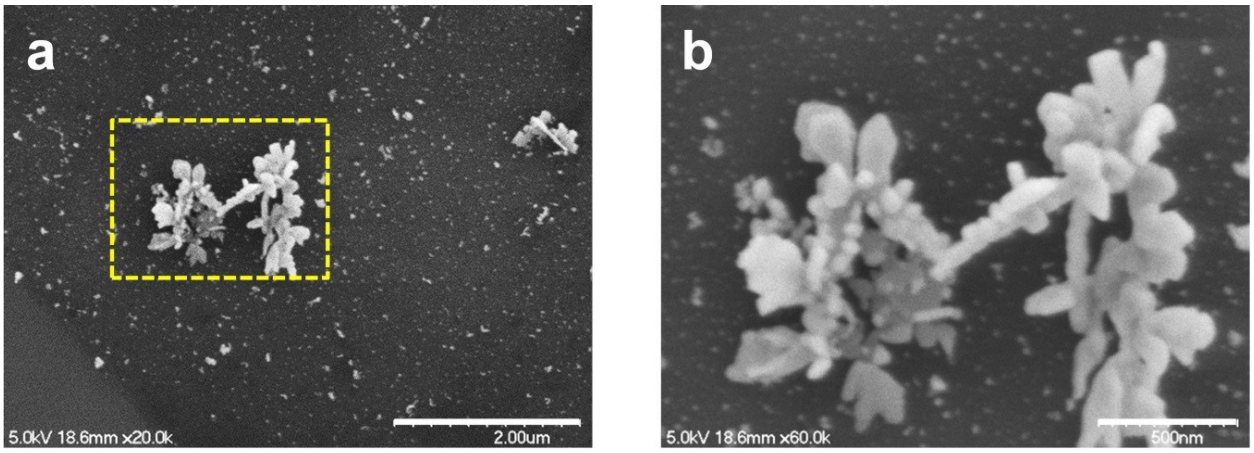

Fig. S4 (a) SEM image of the AgNPs@MoS_2 heterostructures grown on 1 L MoS_2 sheet in 1 mM $AgNO_3$ with 633 nm laser irradiation (25 mW) for 7 s. (b) An enlarged SEM image in the yellow dashed area in (a). Scale bar: 2 μm in (a) and 500 nm in (b).

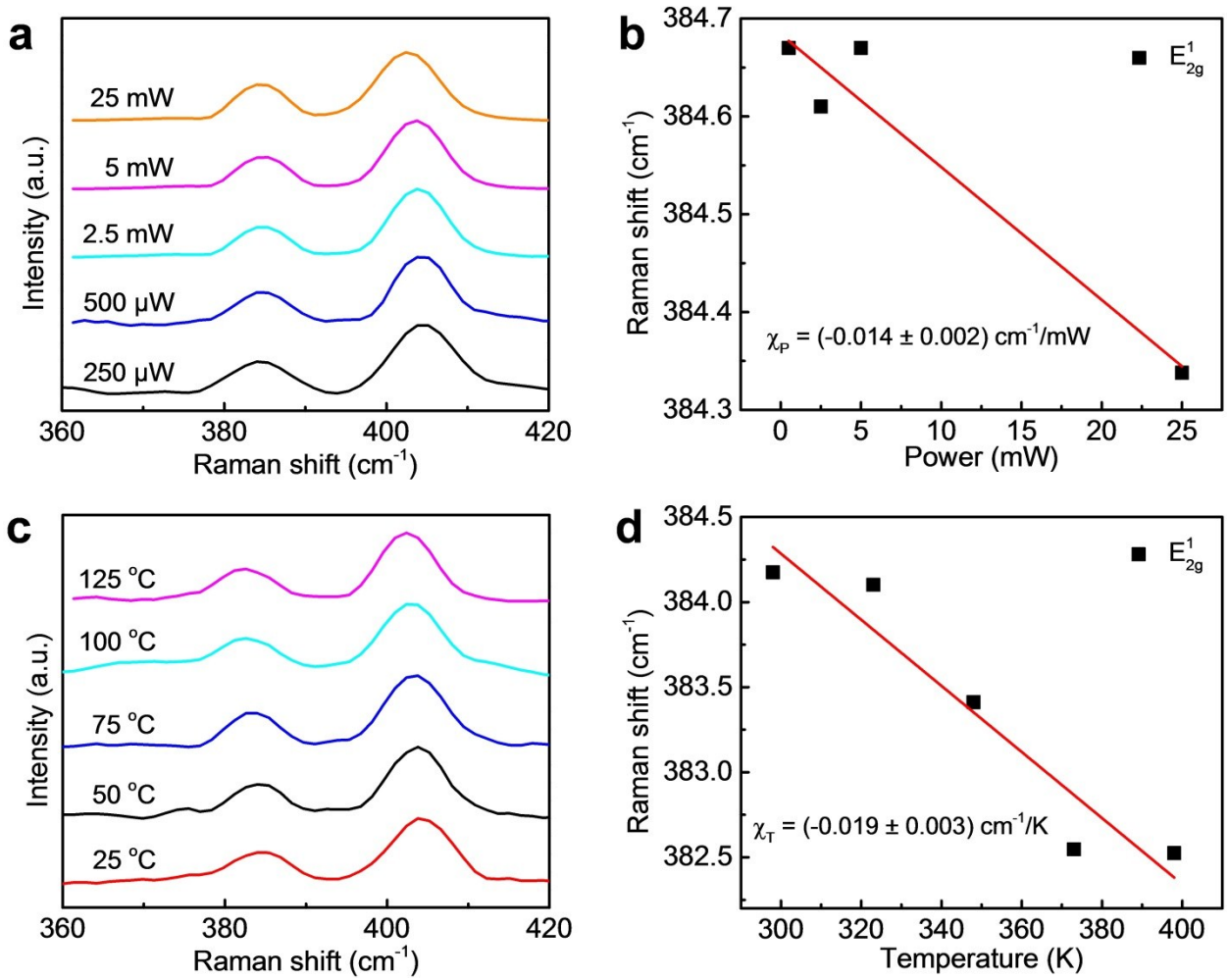

Fig. S5 Temperature increase measurement for 1 L MoS_2 under 633 nm laser irradiation with different laser power. (a) Raman spectra of a 1 L MoS_2 as a function of laser power. (b) The E^1_{2g} peak position as a function of laser power, from which the power coefficient is extracted to be ~ (-0.014 ± 0.002) cm^{-1}/mW. (c) Raman spectra of the same MoS_2 as a function of temperature. (d) The E^1_{2g} peak position as a function of temperature, from which the temperature coefficient is extracted to be ~ (-0.019 ± 0.003) cm^{-1}/K.

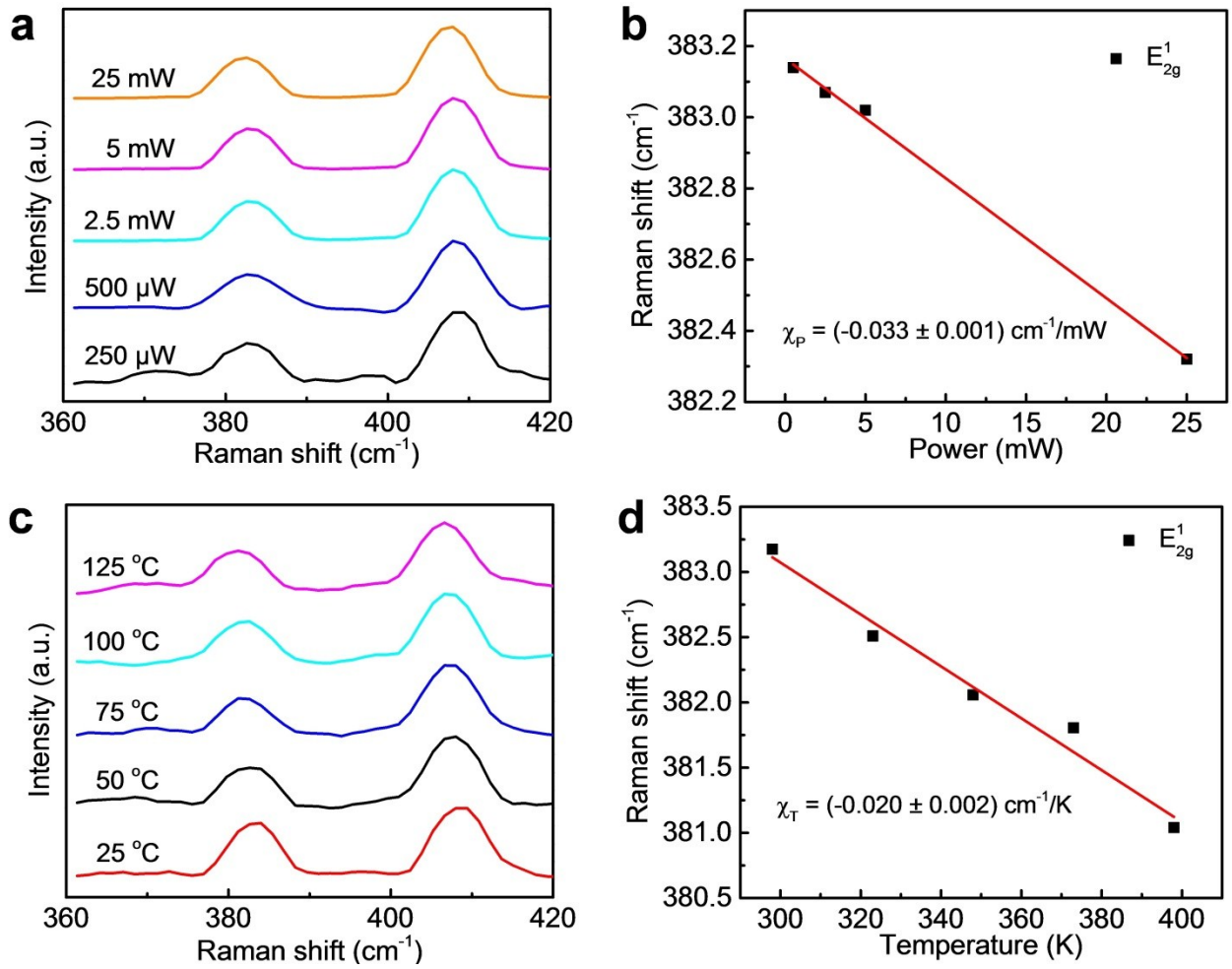

Fig. S6 Temperature increase measurement for multilayer (M L) MoS_2 under 633 nm laser irradiation with different laser power. (a) Raman spectra of a M L MoS_2 as a function of laser power. (b) The E^1_{2g} peak position as a function of laser power, from which the power coefficient is extracted to be ~ (-0.033 ± 0.001) cm^{-1}/mW. (c) Raman spectra of the same MoS_2 as a function of temperature. (d) The E^1_{2g} peak position as a function of temperature, from which the temperature coefficient is extracted to be ~ (-0.020 ± 0.002) cm^{-1}/K.

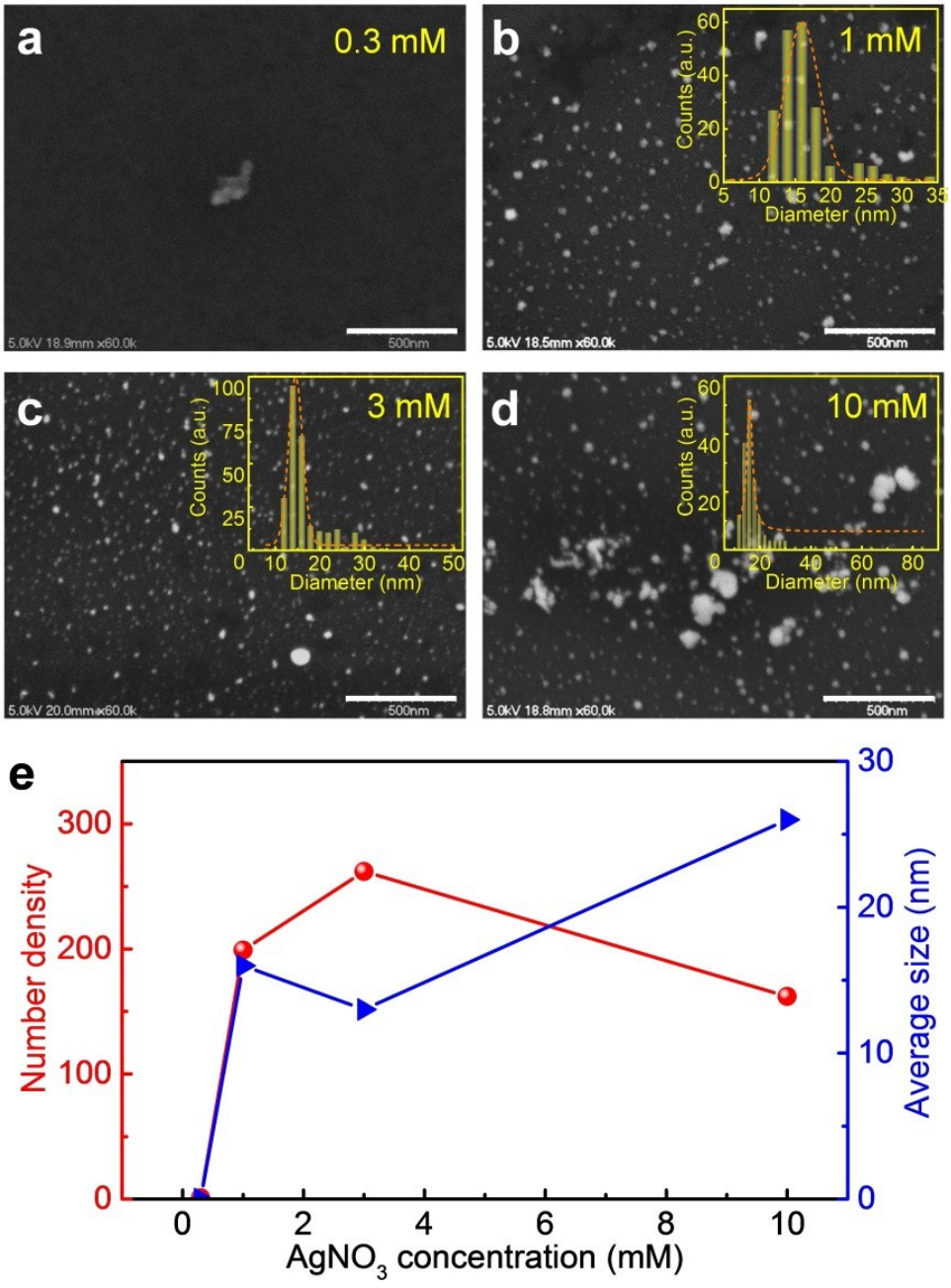

Fig. S7 SEM images of the AgNPs@MoS_2 heterostructures grown with (a) 0.3, (b) 1, (c) 3.0 and (d) 10 mM $AgNO_3$ under 633 nm laser (250 μW) irradiation for 7 s. Scale bar: 500 nm. Insets in (a-d) show the corresponding size histograms of silver NPs deposited on MoS_2 sheets. (e) Size and number density of silver NPs as a function of $AgNO_3$ concentration.

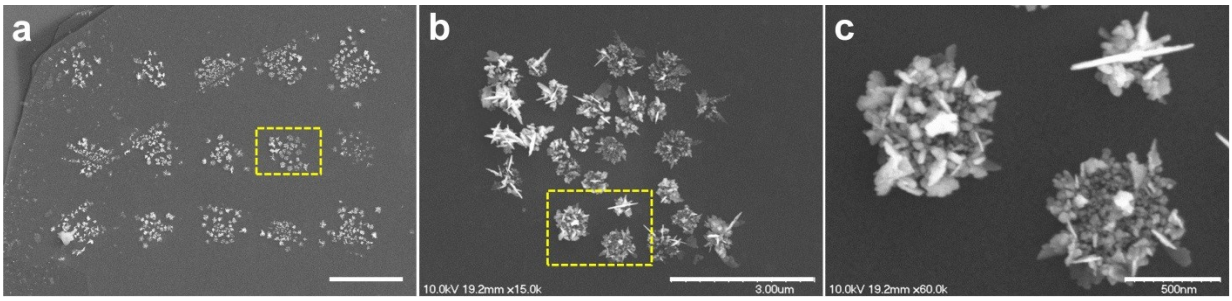

Fig. S8 (a) SEM images of a patterned AgNPs@MoS_2 heterostructures formed on a M L MoS_2 in 0.3 mM $AgNO_3$ solution by a programmed 633 nm laser scan. Scale bar: 10 μm. (b) Enlarged SEM image of the yellow dashed box in (a). Scale bar: 3 μm. (c) Enlarged SEM image of yellow dashed area in (b). Scale bar: 500 nm.

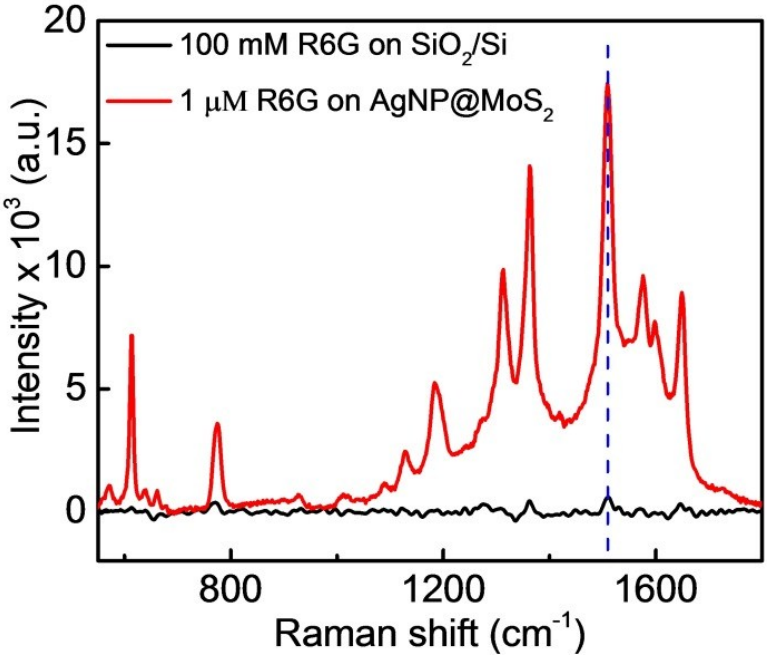

Fig. S9 Enhancement factor calculation of as-fabricated AgNPs@MoS_2 heterostructures. Raman spectra of 100 mM R6G measured on bare SiO_2/Si substrate (black) and 1 μM R6G on AgNPs@MoS_2 heterostructures (red).

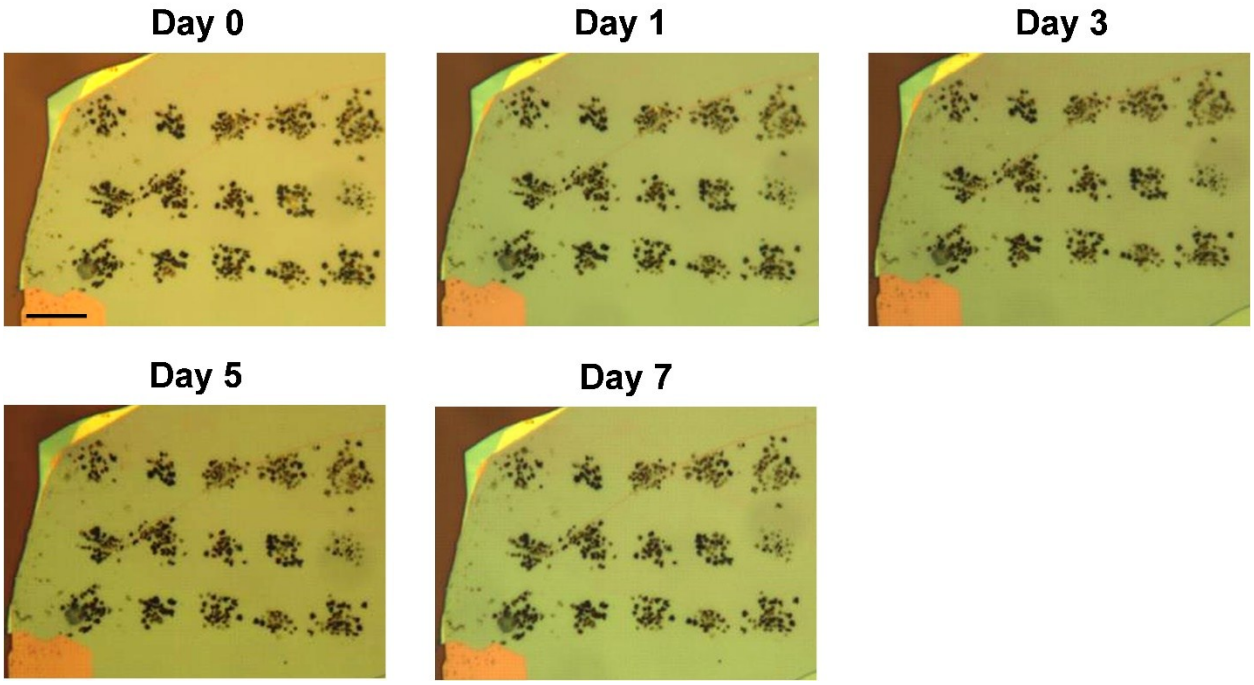

Fig. S10 Stability test of the as-fabricated AgNPs@MoS_2 heterostructures by immersing the sample in deionized water for 7 days. Scale bar: 10 μm.