Supporting Information for:

Formation of Brightly Luminescent MoS_2 Nano-Islands from Multi-Layer Flakes via Plasma Treatment and Laser Exposure

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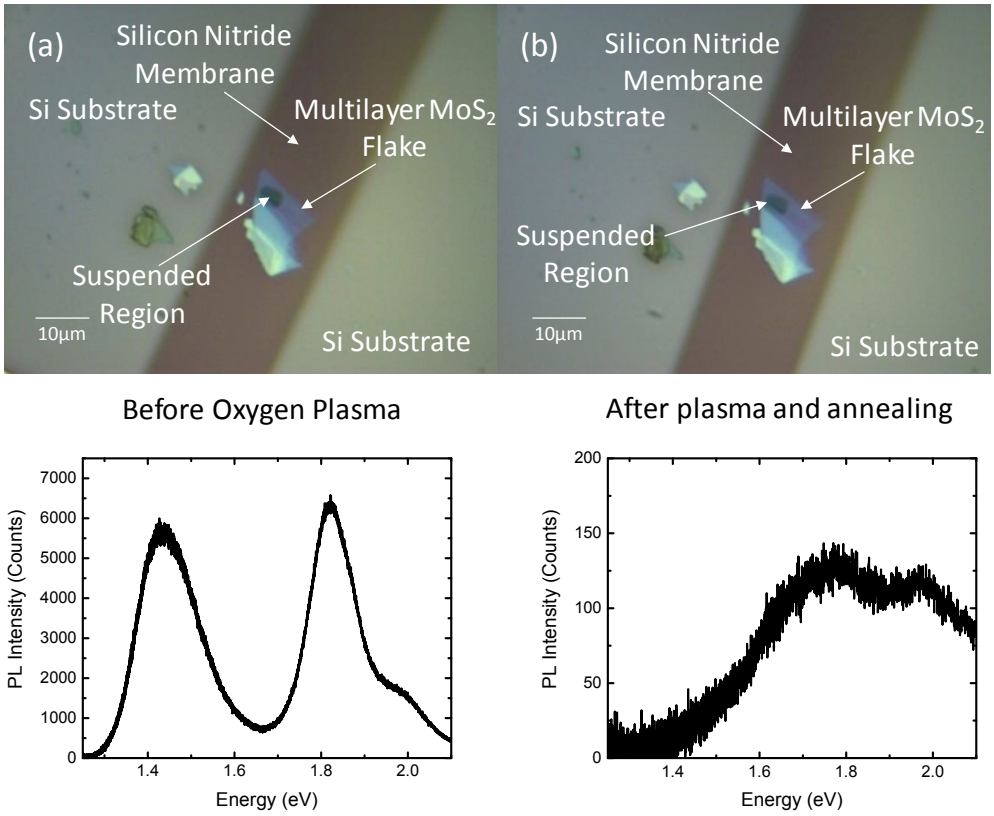

Figure S1. Optical images and PL spectra taken from another suspended MoS_2 flake of (a) before treatment and (b) after oxygen plasma treatment and thermal annealing in Argon.

Figure S2 shows optical microscope and AFM images of a few-layer MoS_2 flake after plasma treatment and laser exposure, in which the letters "USC" were raster scanned on a bilayer portion. Figure 3b shows an AFM image of a localized region in which the ~1 μm focused laser spot of the flake was exposed for 60 seconds. A line scan of the surface topography is shown in Figure 3c, showing an increase in thickness of 2 nm in the region that had undergone laser exposure. This increase in thickness is consistent with the formation of MoO_3, which has a larger thickness than MoS_2[1, 2]. The "USC" region did not get burned or damaged from the laser exposure and exhibit a significantly enhanced photoluminescence than the surrounding bilayer regions. This increase in thickness is somewhat surprising since it occurs in regions that are generally lighter than the surrounding unexposed region. This increased transparency is consistent with the transition to MoO_3, which has a relatively wide band gap.

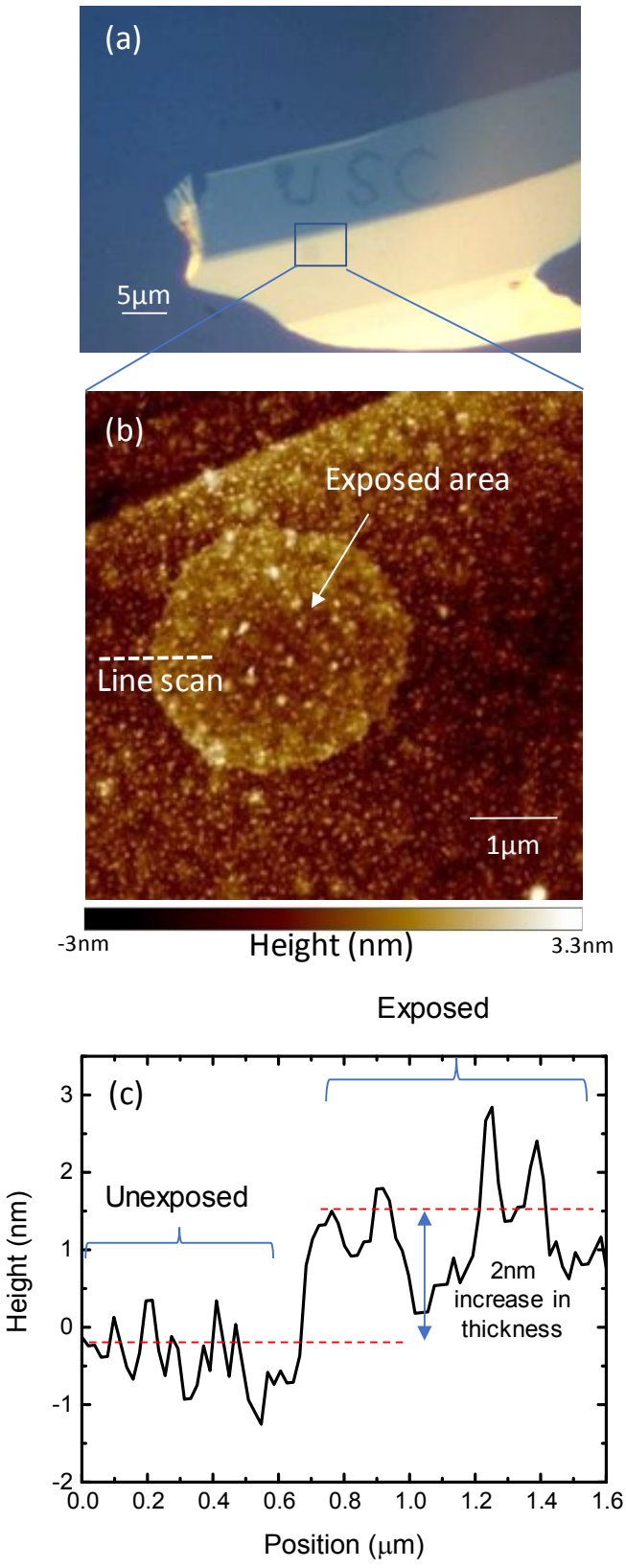

Figure S2. (a) Optical microscope and (b) AFM image of an MoS_2 flake deposited on a silicon nitride substrate. (c) A line scan of the surface topography along the dashed line indicated in (b).

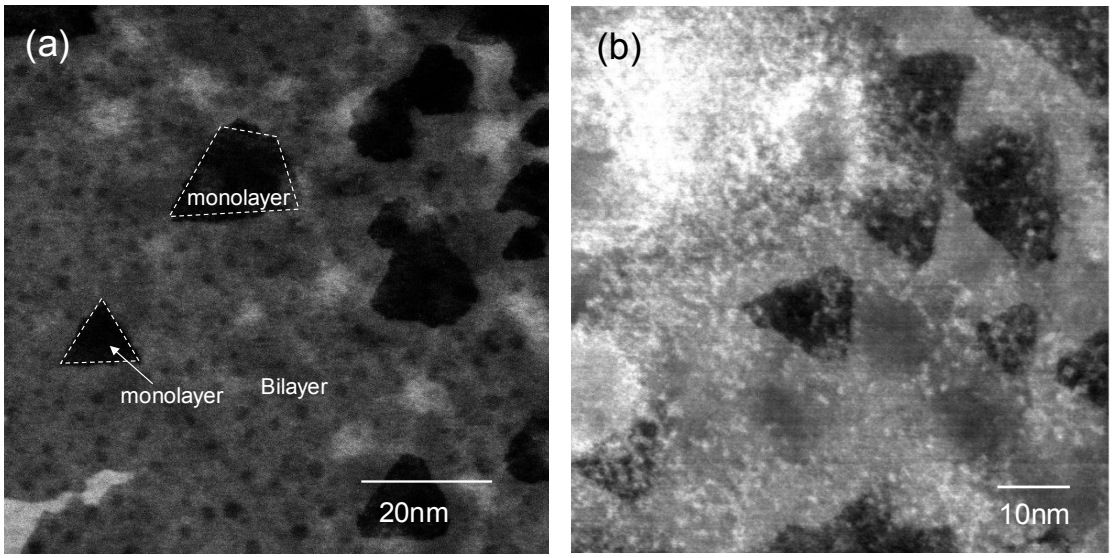

Figure S3. (a), (b) Low magnification TEM images of oxygen plasma treated and laser exposed MoS_2.

[1] Ma, W., Alonso-González, P., Li, S., Nikitin, A., Yuan, J., Martín-Sánchez, J., Taboada Gutiérrez, J., Amenabar, I., Li, P., Vélez, S., Tollan, C., Dai, Z., Zhang, Y., Sriram, S., Kalantar-zadeh, K., Lee, S.-T., Hillenbrand, R., and Bao, Q. In-plane anisotropic and ultra-low-loss polaritons in a natural van der Waals crystal. *Nature* **2018**, *562*

[2] Huang, P.; He, Y.; Cao, C.; Lu, Z.-H. Impact of lattice distortion and electron doping on α-MoO3 electronic structure. *Sci. Rep-UK.* **2014**, *4*, 7131.