Supporting Information

Strain, doping and electronic transport of large area monolayer MoS_2 exfoliated on gold and transferred to an insulating substrate

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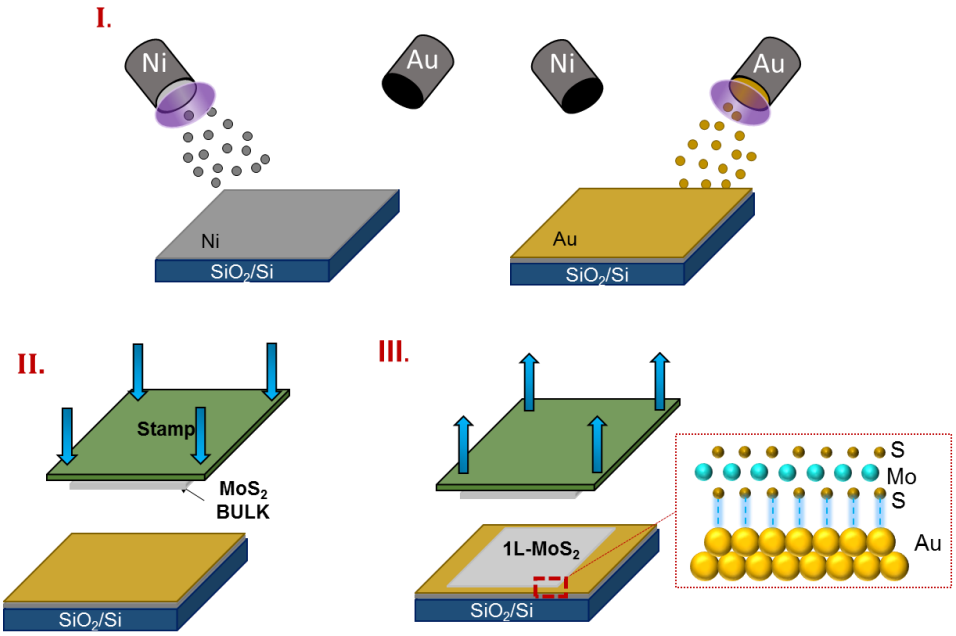

Figure S1 Schematic illustration of the procedure for monolayer (1L) MoS_2 exfoliation on Au/Ni/SiO_2. (I) Sequential sputtering of Ni (adhesion layer) and Au on the SiO_2/Si substrate. (II) Pressing of bulk MoS_2 on the Au surface. (III) Separation of 1L-MoS2 due to the strong interaction between S and topmost Au atoms.

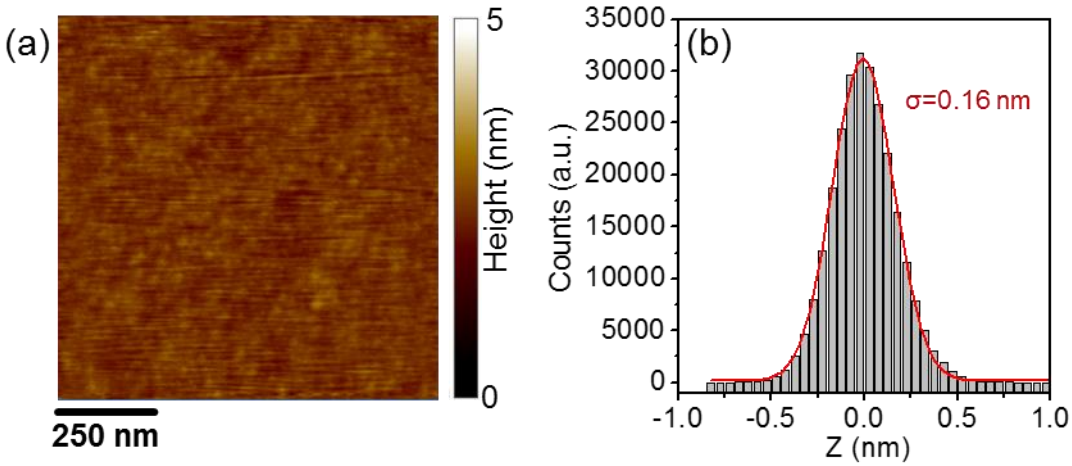

Figure S2 (a) Tapping mode Atomic Force Microscopy image of the Au surface morphology in Au/Ni/SiO_2 samples. (b) Z-values distribution and Gaussian fit, with the standard deviation (roughness) σ=0.16 nm.

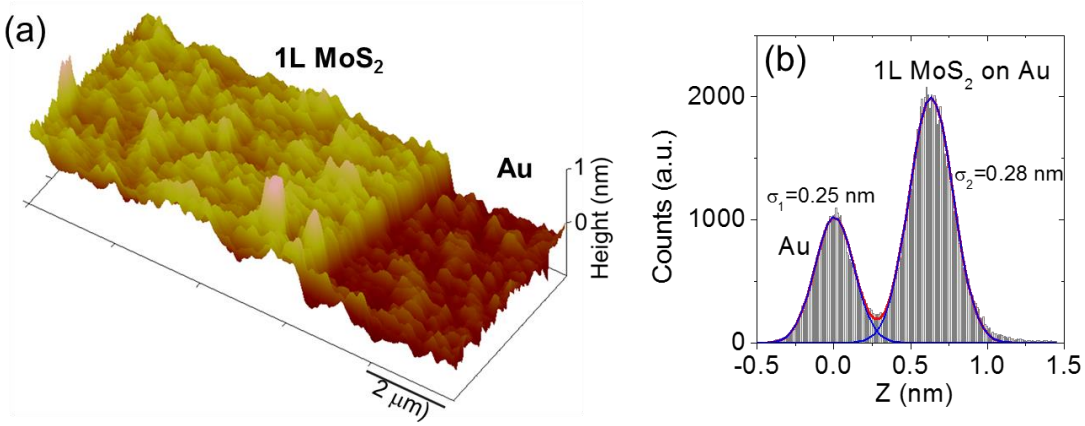

Figure S3 1L MoS_2 exfoliated on Au. (a) AFM morphology of a region where MoS_2 partially covers the Au surface. (b) Corresponding histogram of height distribution, showing two components, associated to the bare Au region and to 1L MoS_2/Au. Very small and comparable values of roughness (σ_1=0.25 nm and σ_2=0.28 nm) can be deduced for both areas.

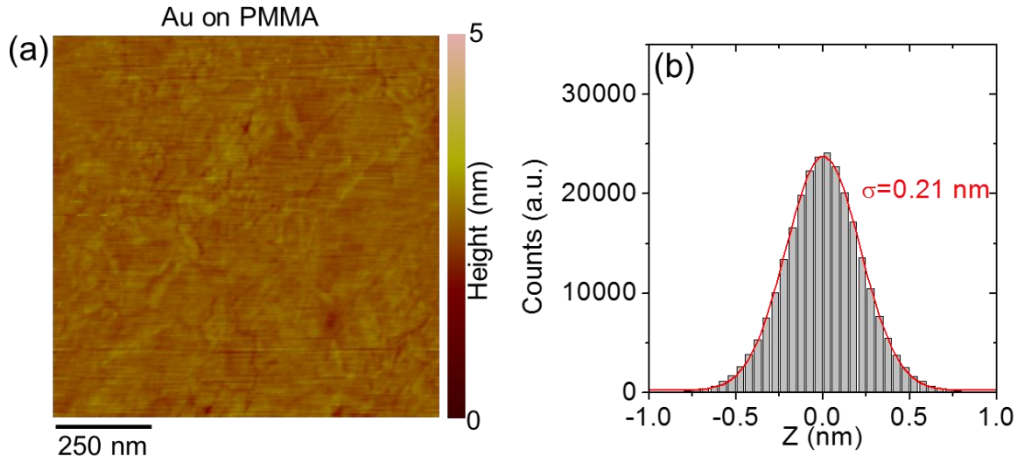

Figure S4 (a) AFM morphology of the peeled gold on PMMA and (b) corresponding histogram of height distribution, showing a very small roughness of 0.21 nm, comparable with that of the Au/Ni film on SiO_2.

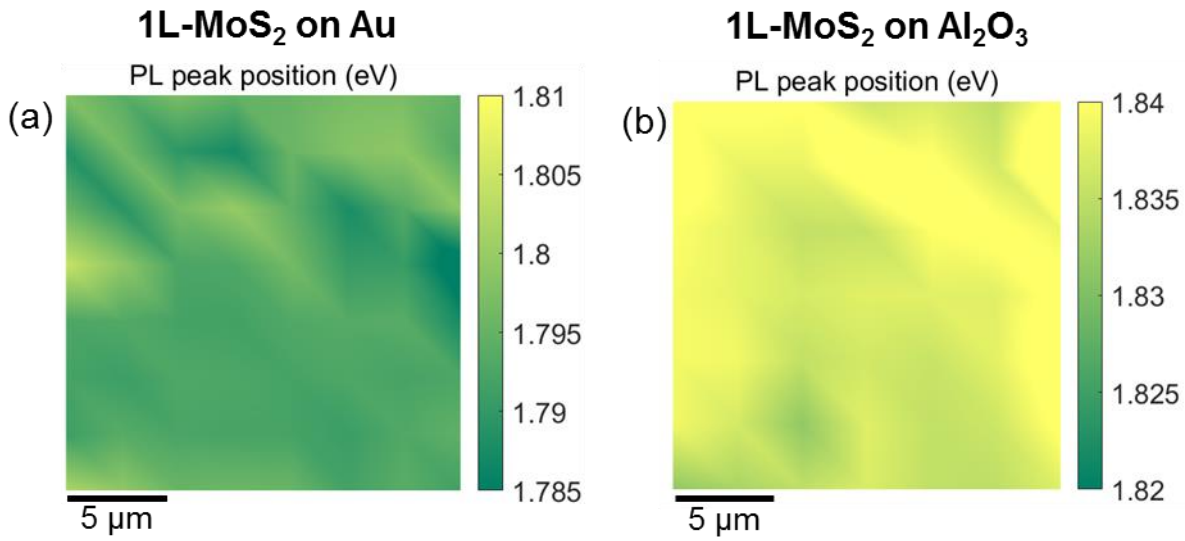

Figure S5 Colour maps of the PL peak energy obtained from arrays of microPL spectra collected on 1L MoS_2 exfoliated on Au (a) and after transfer on Al_2O_3 (b).

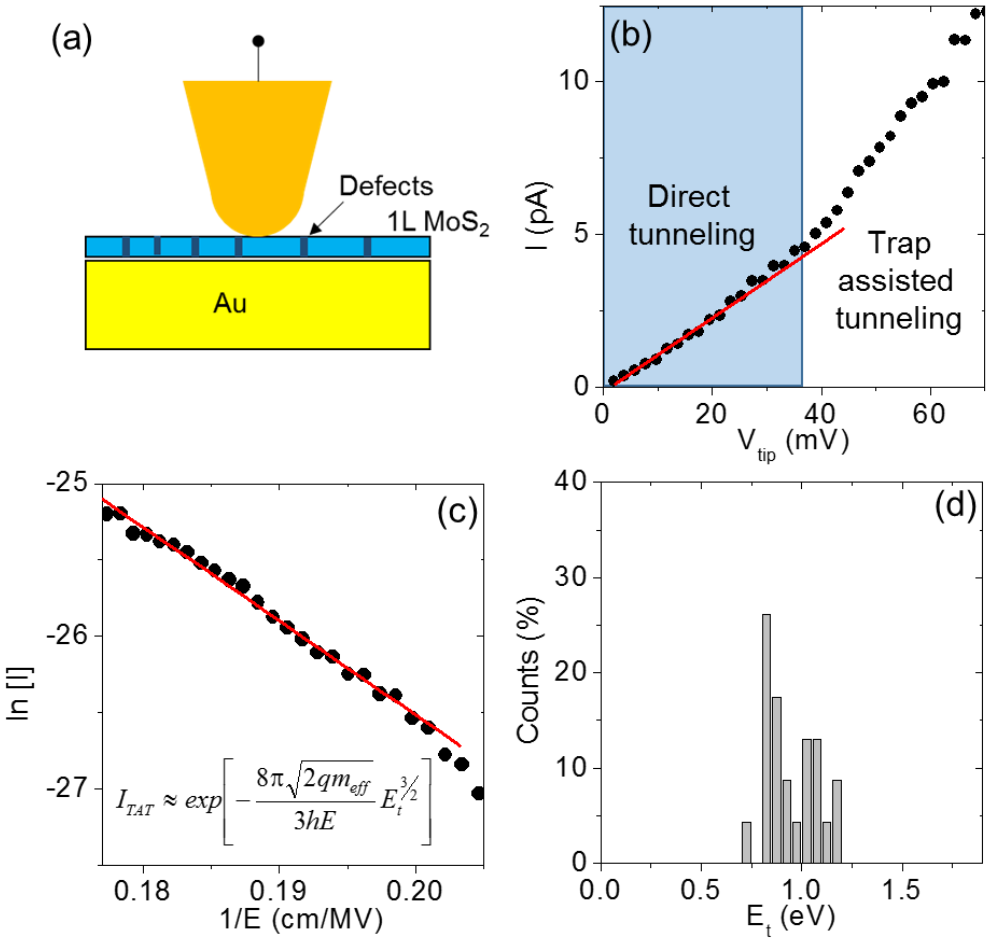

Figure S6 (a) Schematic of the tip/MoS_2/Au system, where the presence of defects (e.g. sulfur vacancies) in the 1L MoS_2 has been indicated. (b) Typical I-V_{tip} curve, where two conduction regimes are indicated: a linear regime (at lower bias) ruled by direct tunnelling, and an exponential regime (at higher bias) ruled by trap-assisted-tunnelling. (c) Plof of ln(I) vs 1/E, demonstrating that current can be described by the trap-assisted-tunnelling equation (in the insert). Here, the electric field E was evaluated as $E=(V_{tip}+V_{bb})/d$, where V_{tip} is the tip bias, d=0.65 nm is the thickness of 1L MoS_2 and V_{bb}=0.3V is the average value of the upward band bending of MoS_2 due to p-type doping induced by Au. The trap energy level E_t (referred to the conduction band edge) was evaluated from the linear fit. (d) Histogram of the E_t values obtained by fitting of all the I-V_{tip} curves in Fig.5(d) of the main manuscript.

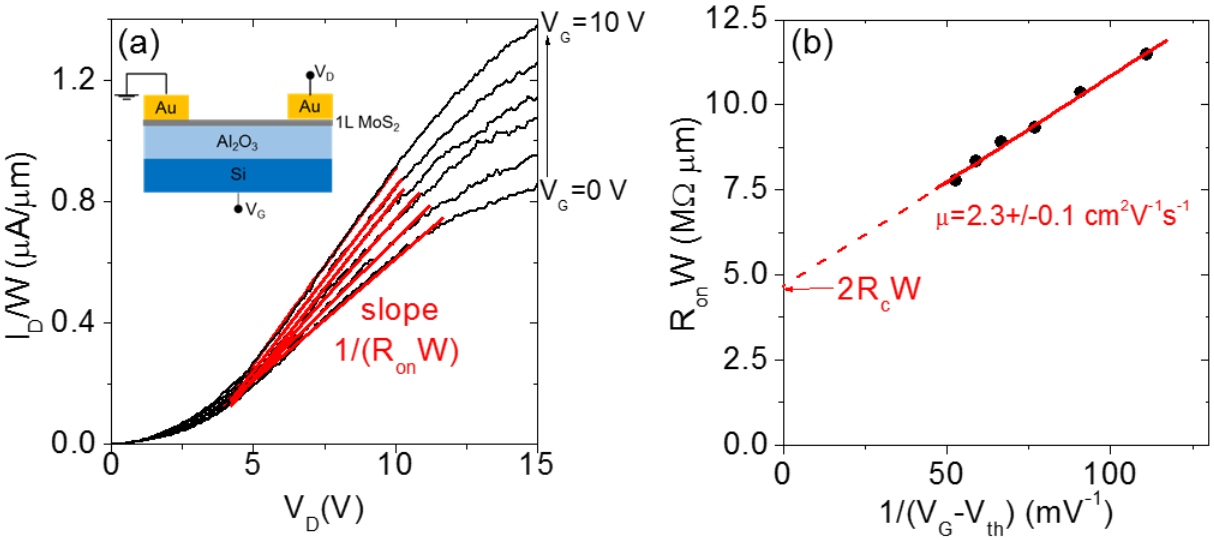

Figure S7 (a) Fitting of the linear region of the output characteristics (I_D/W vs V_D) of the back-gated 1L MoS_2 FET to evaluate the on-resistance $R_{on}W$. (b) Plof of $R_{on}W$ vs $1/(V_G-V_{th})$ and linear fit with the equation $R_{on}W=2R_CW+L/[\mu C_{ox}(V_G-V_{th})]$, where R_CW is the contact resistance, L=10μm is the channel length, μ is the electron mobility, C_{ox} is the capacitance density of 100 nm Al_2O_3, V_{th}=-9 V is the threshold voltage. A contact resistance $R_CW\approx2$ MΩ μm and a mobility $\mu=2.3\pm0.1$ $cm^2V^{-1}s^{-1}$ were evaluated from the linear fit.