Supplementary Information

Strain relaxation in monolayer MoS_2 over flexible substrate

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S1. Strain modulation setup and characterization of as grown MoS_2

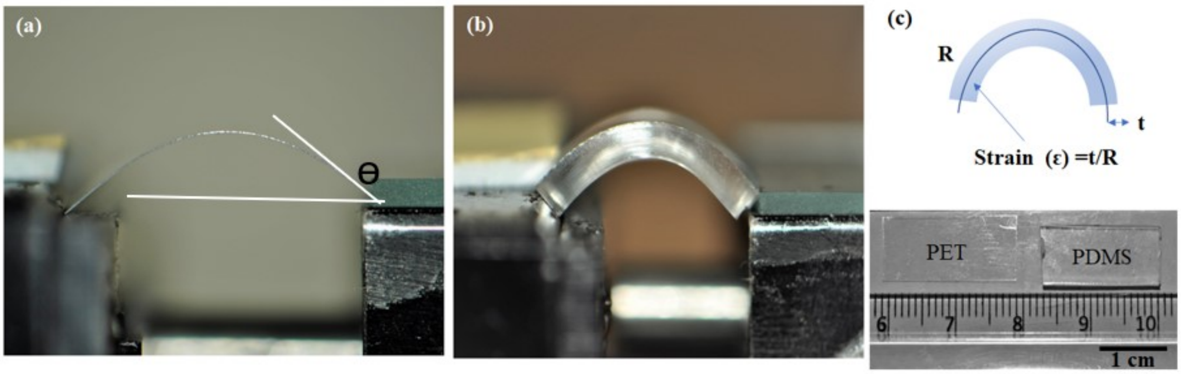

Figure S1. Strain modulation setup used for our experiments (a) 125 µm thick PET under strain and (b) 2 mm thick PDMS under strain (c) Schematics showing calculation for strain measurement.

The % of strain was measured by bending the PET/PDMS. The t thickness of either PET/PDMS is known. The radius of curvature R is calculated by measuring the angle between the tangent and the horizontal for each applied strain from the formula - R = length of chord / (2 sin ɵ). The chord length was measured from the sliding vernier callipers which was used to bend the PET/PDMS.

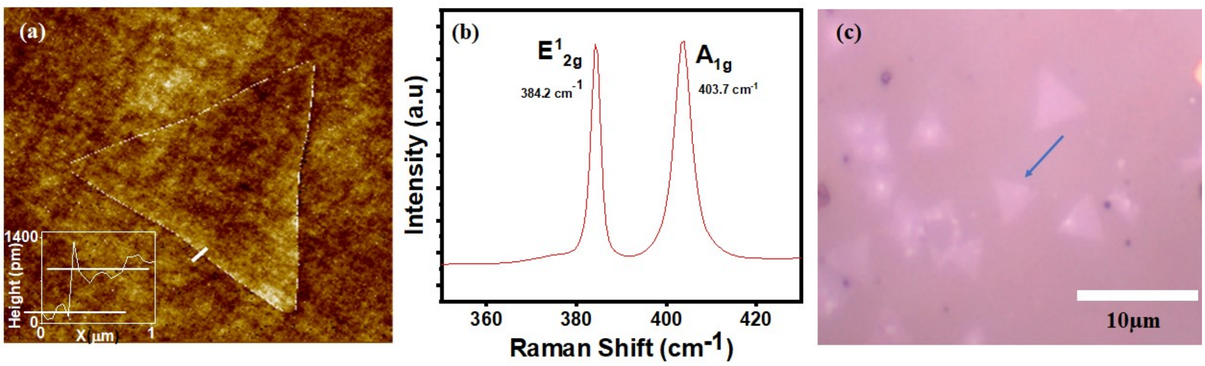

Figure S2. (a) AFM micrograph of 1L MoS_2 over SiO_2/Si substrate. Inset shows the height profile with 0.83 nm thickness. The measured thickness of the as-synthesized MoS_2 over SiO_2/Si shows that they are monolayer in nature. (b) Raman spectra of 1L MoS_2 over SiO_2/Si. The difference between the E^1_{2g} and A_{1g} peak is 19.5 cm^{-1}, which is consistent with the reported literature for 1 L MoS_2 on SiO_2/Si . (c) In-situ optical micrograph of the particular flake over PET whose Raman data is shown in figure 1 (a & b).

S2. Strain modulation in a single grain 1L MoS_2 flake

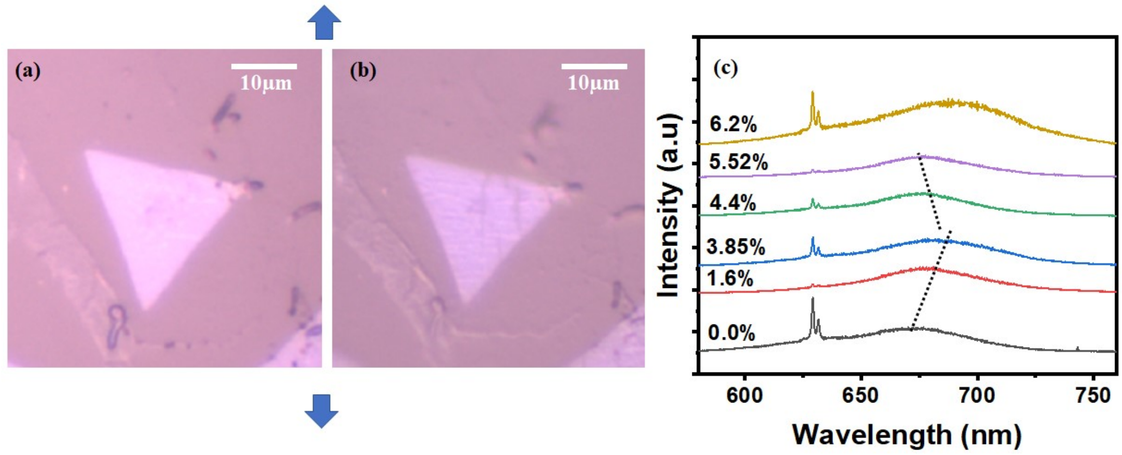

Figure S3. In-situ optical micrograph of another 1L MoS_2 flake over PDMS (a) before strain and (b) at 4.4% strain. (c) PL spectra of the particular flake marked in (a & b). The arrows indicate the strain axis.

There is a gradual redshift in PL spectra up to 3.85 % strain, further increasing the strain a blue shift is observed at 4.4 %, which indicates the start of the strain relaxation process which continues up to 5.52 %. For the single grain flake cracks appear along the strain axis which similar is like the double grain flake.

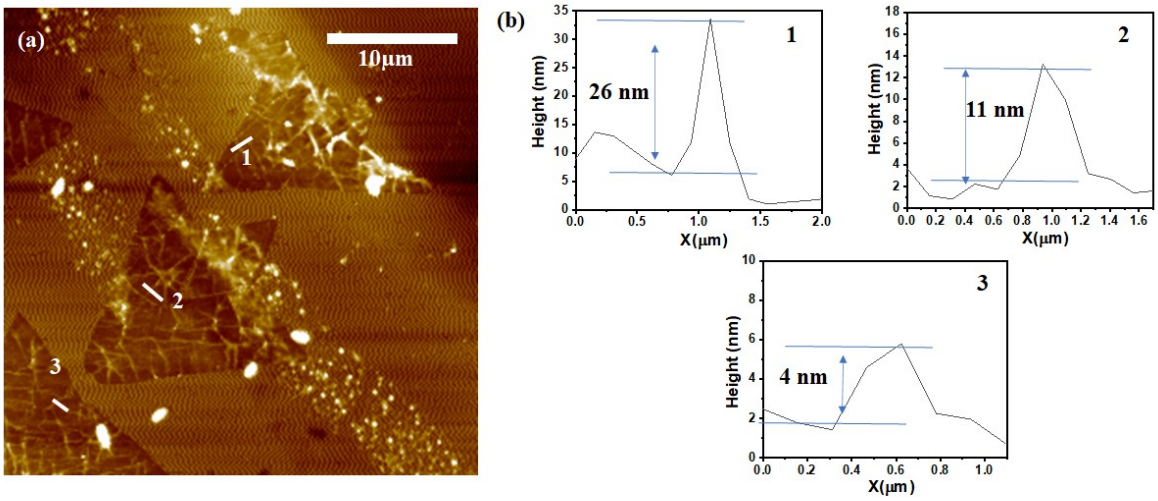

Figure S4. (a) Ex-situ AFM of other 1L MoS_2 flakes over PDMS after strain modulation. Cracks are clearly visible over all the flakes. (b) Height profile of the wrinkles marked in (a).

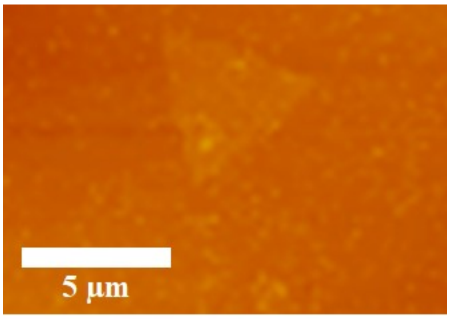

Figure S5. AFM micrograph of 1L MoS_2 after transferring over PDMS and before the application of strain. Clearly no cracks or wrinkles are visible.

S3. Simulation of the variation of strain over pet

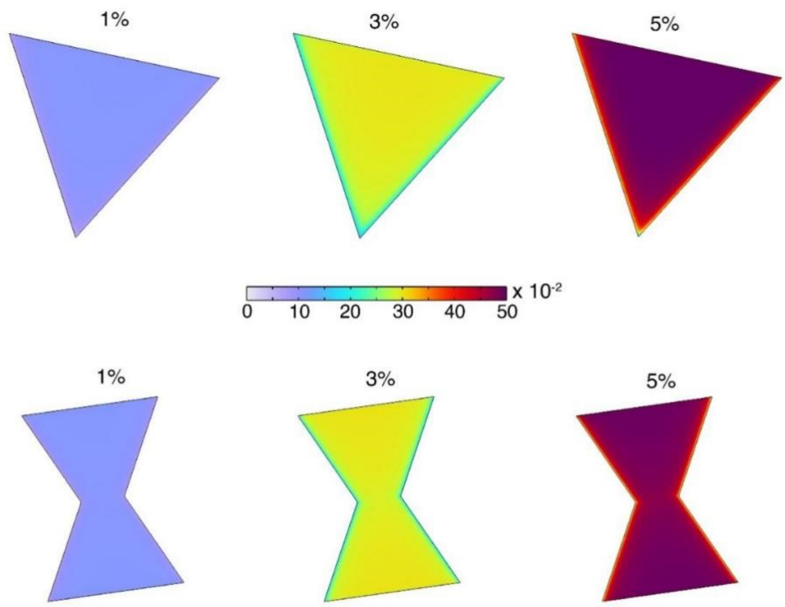

Figure S6. The strain variation on the single and double grain 1L MoS_2 transferred over the PET substrate.

Table S1. Materials and their parameters used for the simulations.

Materials	Young's Modulus (Pa)	Poisson ratio
PDMS	1.527 x 10^6	0.483
PET	3.45 x 10^9	0.43
MoS_2	300 x 10^9	0.25

a