An Automated System for Strain Engineering and Straintronics of Single-Layer MoS_2

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Strain engineering in 2D materials has received extensive attention. Research in the field has already demonstrated piezoelectricity[1], bandgap tuning[2] and enhancement of thermoelectric figures of merit[3]. However, typical straining setups consist of manual micromanipulators[4] and have measurement limitations in long time and short strain intervals. The experimental results also suffer from accuracy because of these limitations. Therefore, we constructed a new setup with a motorized vertical translation stage and controlled it by PC. After calibration, the lowest strain value has been found as ~10^{-6} %. Then, we have tested the setup by performing differential reflectance, photoluminescence, Raman spectroscopy, IV measurement and photoresponsivity on monolayer MoS_2 with several cycles. Gauge factors calculated in each measurement were found comparable with the previous results in literature. The setup can be a good candidate for straining experiments in a long time in order to discover their performance optically and electrically. Moreover, the measurements demonstrate lower strain interval and more repeatable cycles can lead to higher accuracy as well.

References

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[4] Carrascoso, F., Li, H., Frisenda, R. & Castellanos-Gomez, A. Strain engineering in single-, bi- and tri-layer MoS2, MoSe2, WS2 and WSe2. Nano Res. 14 (2021), 1698–1703.

Figures

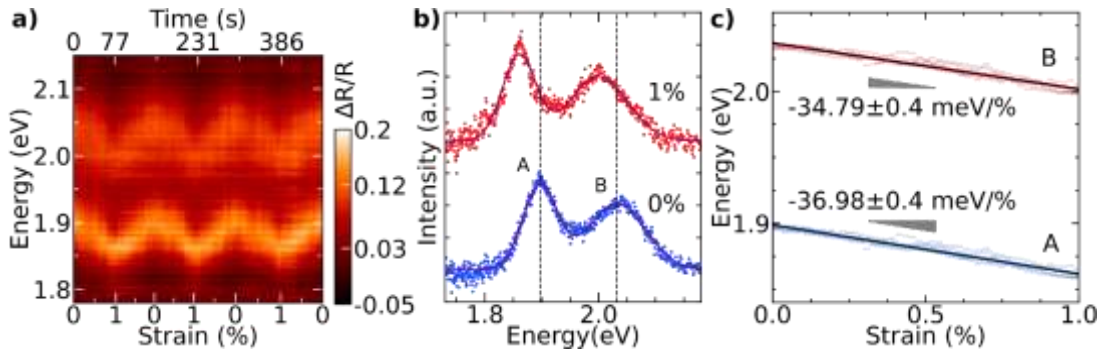

Figure 1: Strain tunable differential reflectance (ΔR/R) in monolayer MoS2. a) Evolution of ΔR/R of MoS2 in 3 strain load/unload cycles. b) Comparison of two ΔR/R at different strain values. c) A and B exciton peak energies as a function of tensile strain.