In-situ Oxygen-driven Growth Regulation and Defect Passivation in Chemical Vapor Deposited MoS_2 Monolayers

Presented
by
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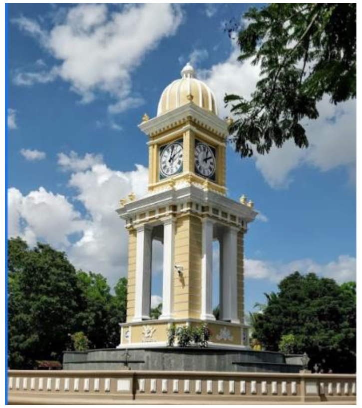
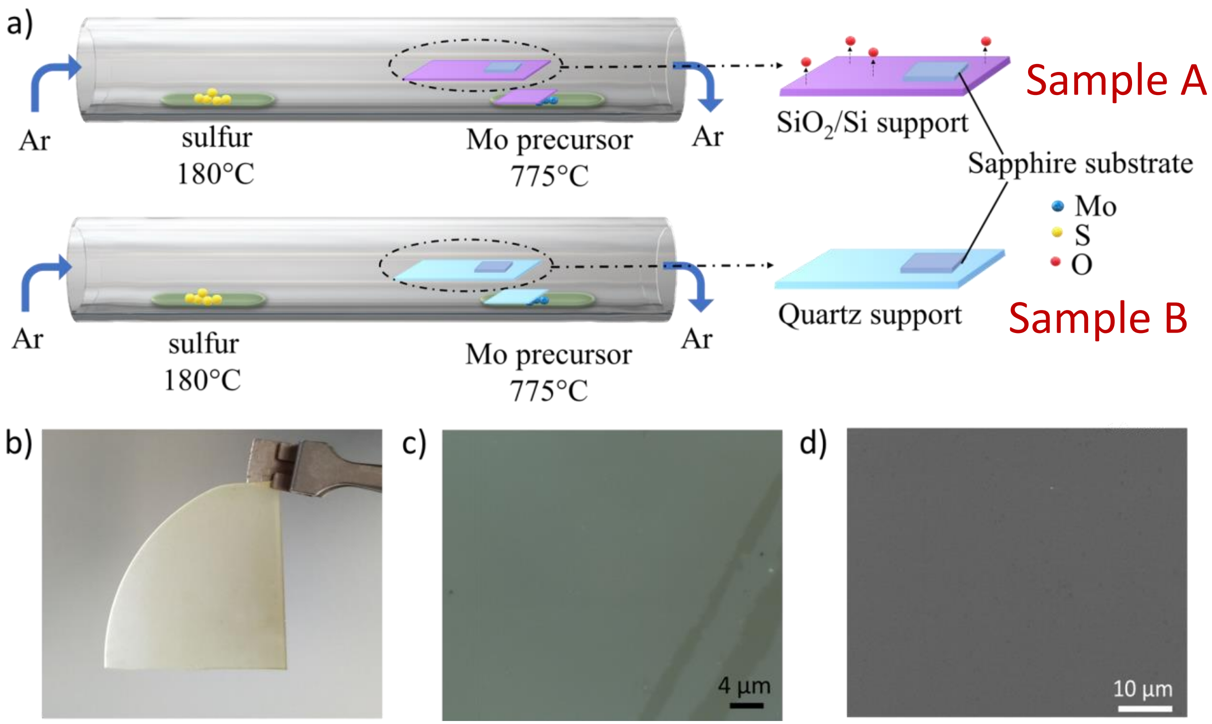
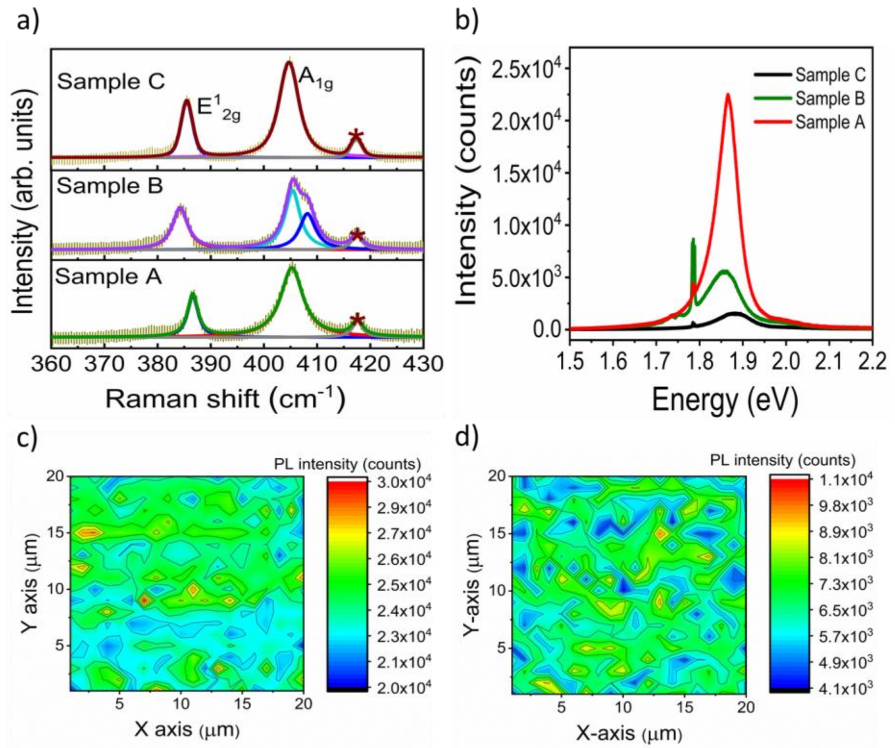
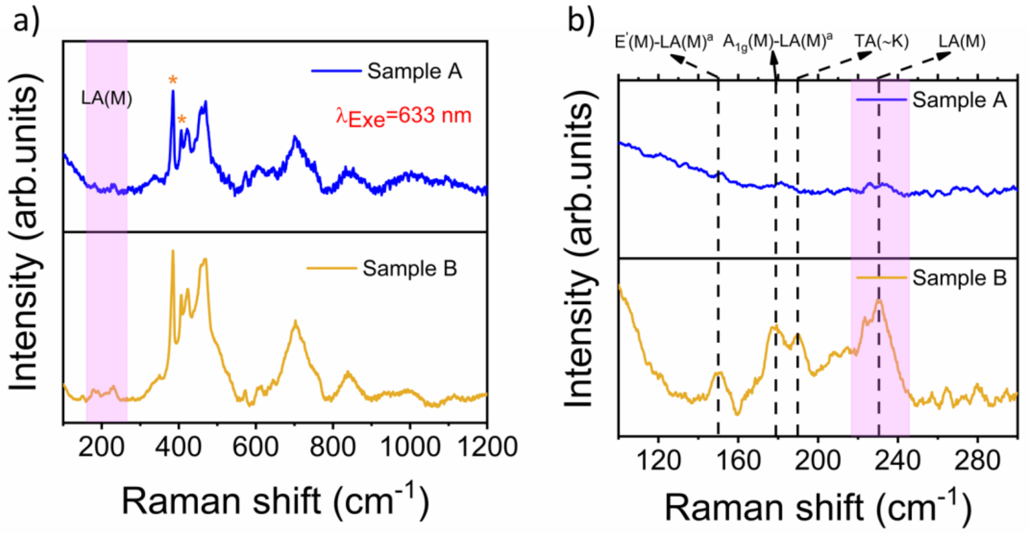




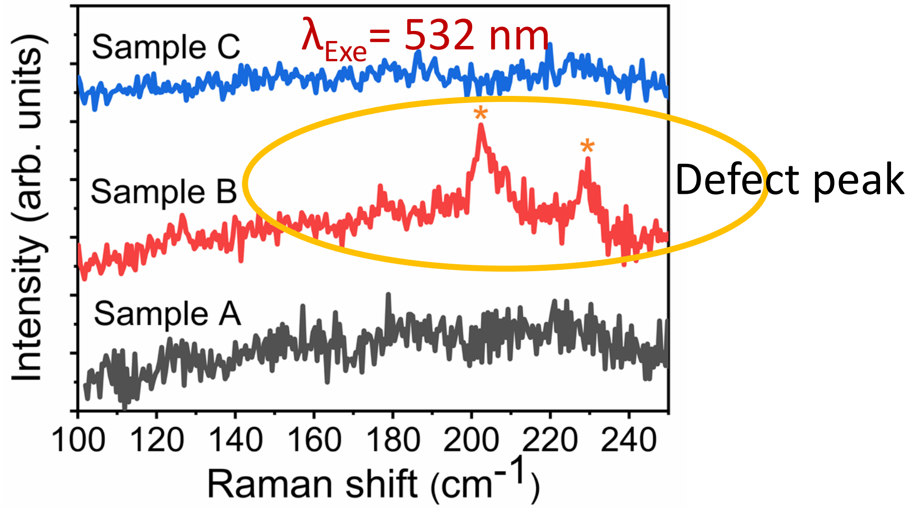
(a) Schematic diagram of the experimental setup used growth of MoS_2 (b) photograph of the grown MoS_2 on sapphire substrate (c,d) Optical microscope and HRSEM image of MoS_2



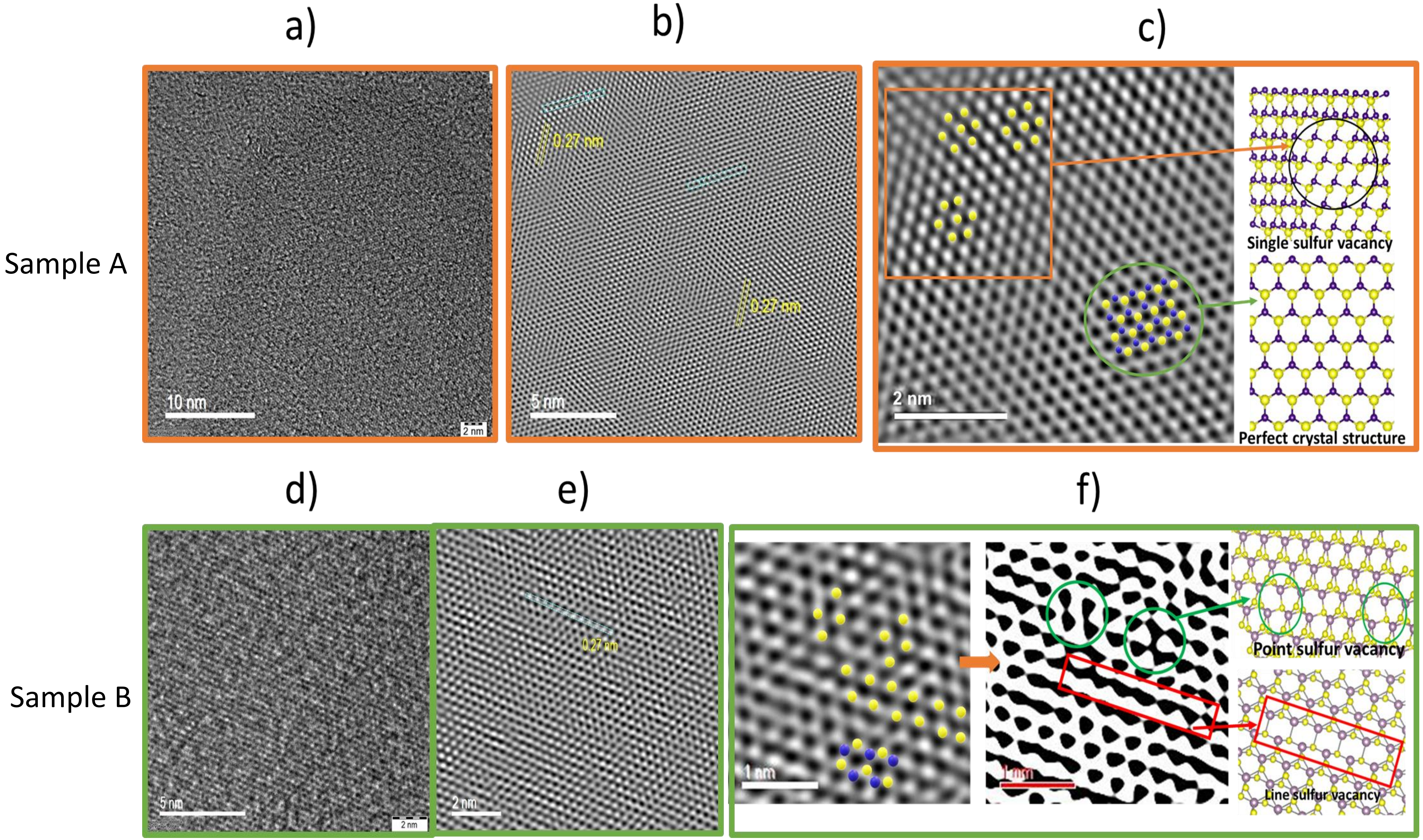
(a) Raman spectra of sample A (SiO2 support), sample B (quartz support) and sample C (Gas phase) CVD (b) µ-PL spectra of sample A, B and C (c,d) PL intensity maps of sample A and B



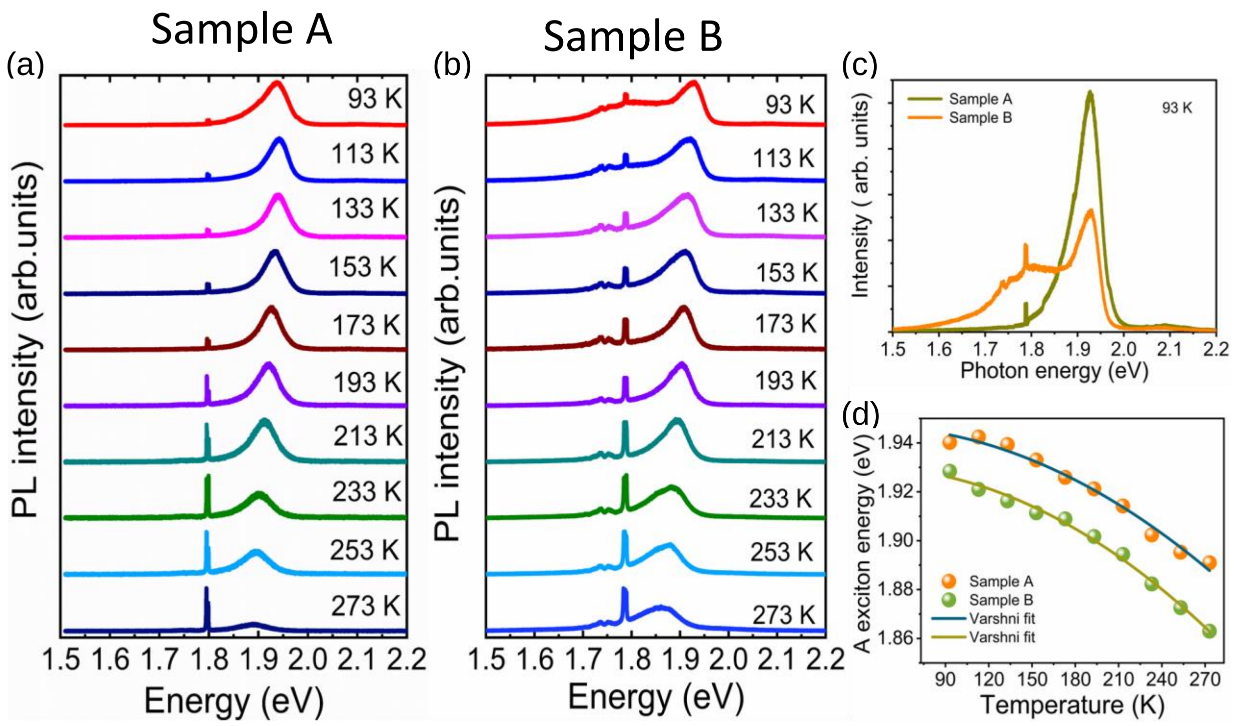
(a, b) Resonance Raman spectra of sample A and sample B



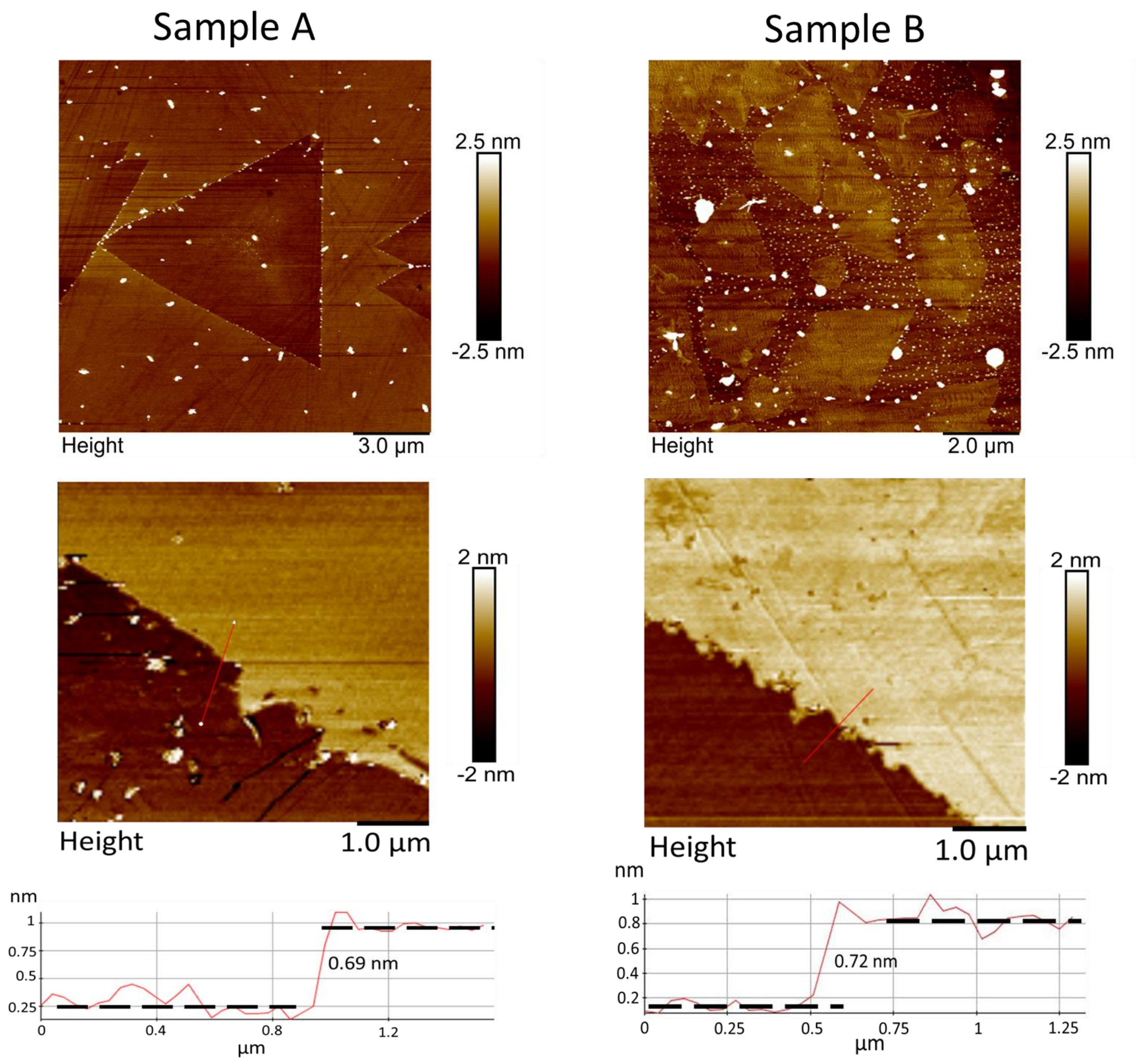
Raman spectra of MoS_2 samples in the frequency range from 100-250 cm^{-1}



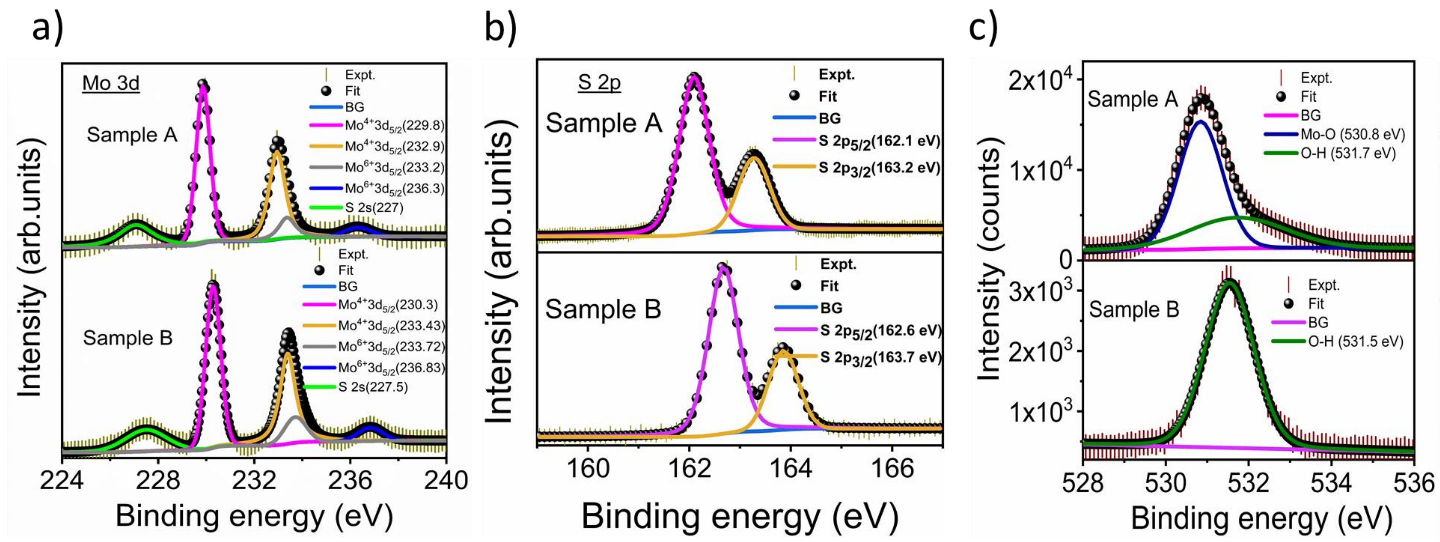
HRTEM analysis of the grown MoS_2 films. Figure (a) shows the raw image and (b) and (c) are the inverse FFT images of sample A. The raw and inverse FFT images of sample B are shown in (d) and (e-f), respectively.



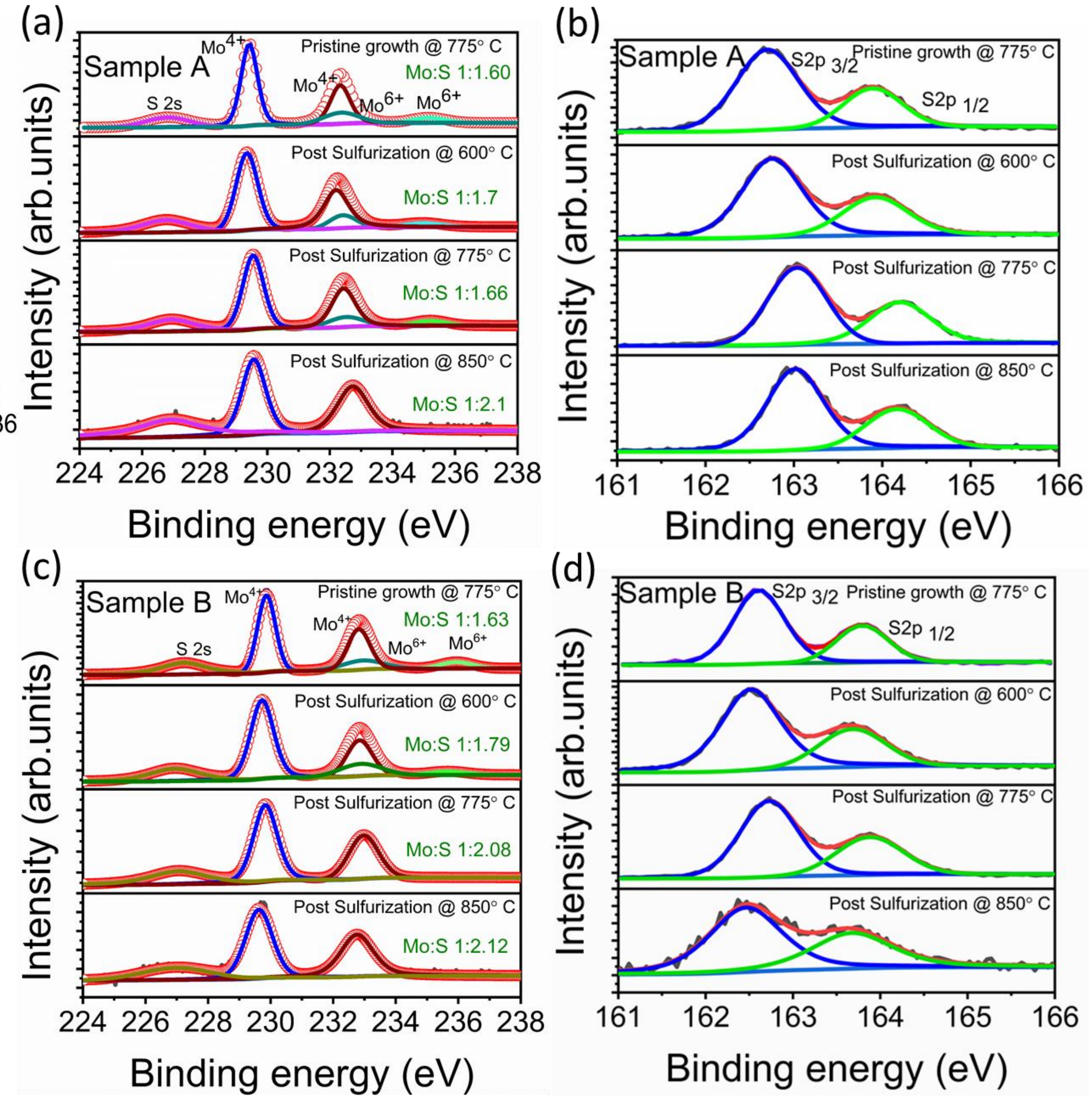
Temperature-dependent μ-PL spectra of MoS_2 for (a) sample A and (b) sample B. (c) Comparison of the PL spectrum recorded at 93 K. (d) Variation in the A exciton energy with temperature. The solid lines are Varshni fit to the experimental data.



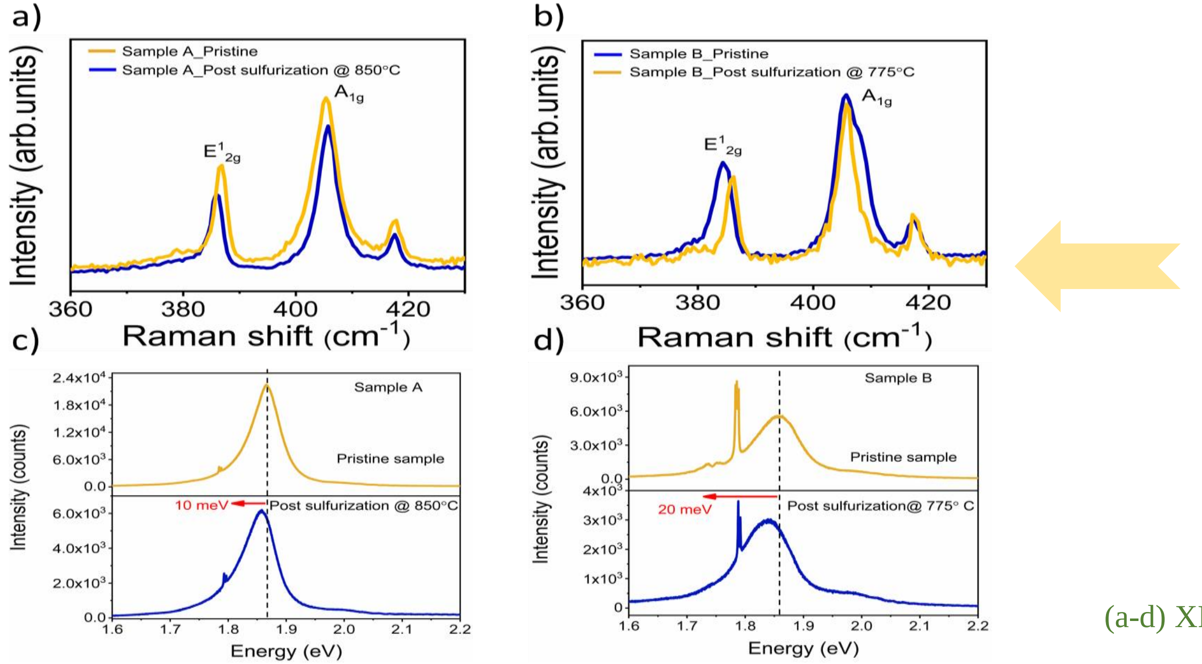
AFM topography images of MoS_2 domains and continuous film of sample A and sample B



(a-c) XPS detail scan spectrum of (a) Mo 3d, (b) S 2p and (c) O 1s core levels for samples A and B.

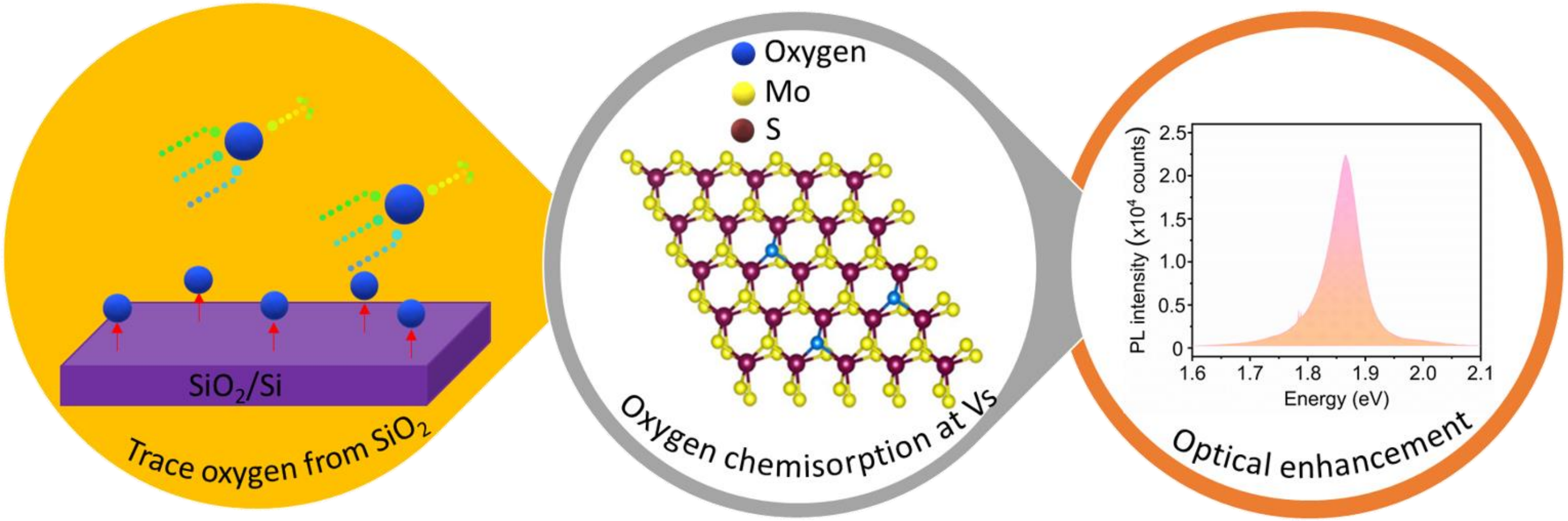


(a-d) XPS analysis of MoS_2 samples before and after post sulfurization at different temperatures



(a-d) Raman and μ-PL spectra of MoS_2 samples before and after post sulfurization

Conclusion



- An effective method for passivating the V_S *in situ* by using an oxide substrate in the vapor phase CVD
- The chemisorbed oxygen is found to have a strong impact on the defect sites such that it transforms the localized trap states to electronically benevolent sites, which exhibited very strong band edge photoluminescence
- In the absence of oxygen, the growth of MoS_2 and its structure is greatly altered. The present findings also provided new insights into the phonon behavior in highly defective monolayer MoS_2

Acknowledgements:

- We acknowledge financial support from the Science and Engineering Research Board, Department of Science and Technology, Government of India, under Research Grant No. CRG/2020/003902 and ECR/2016/000918.

- We thank SRMIST for the generous support to establish micro-Raman, HRTEM and X-ray Photoelectron Spectroscopy facilities.

- Dr. Jong Bae Park (Jeonju Center, Korea Basic Science Institute, South Korea) & Dr. Vijayshankar Asokan (Environmental Inorganic Chemistry, Department of Chemistry and Chemical Engineering, Chalmers University of Technology, Sweden)