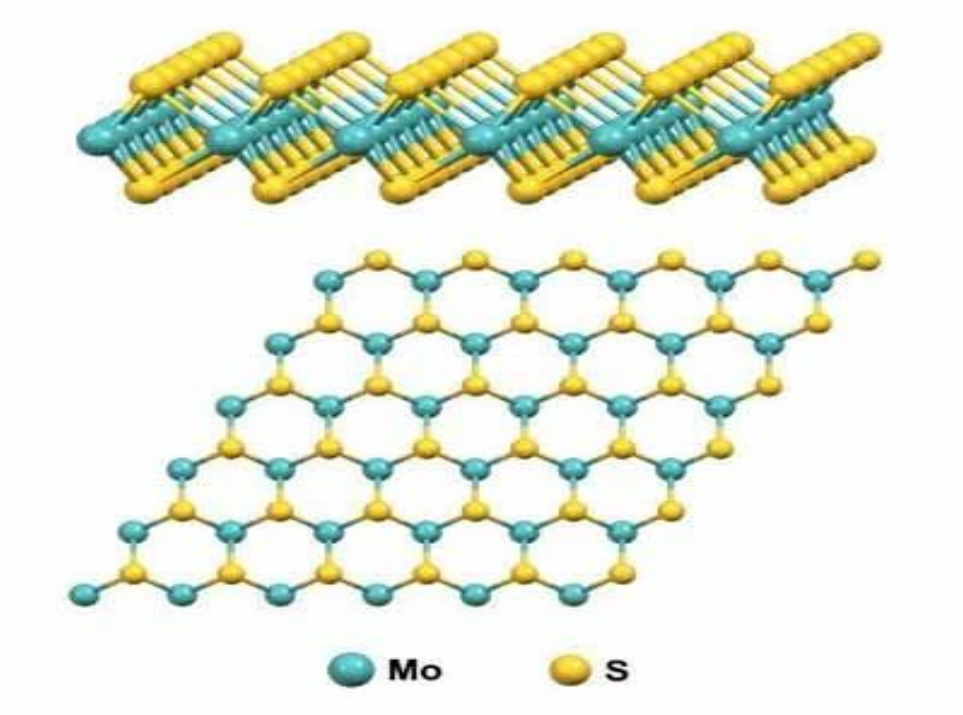
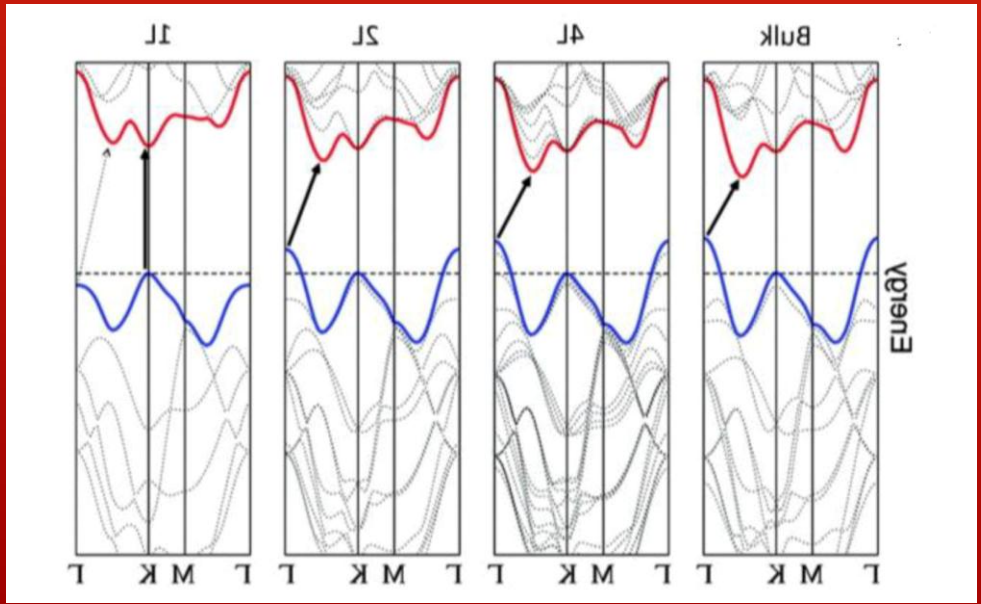
DIRECT SYNTHESIS OF VERTICAL MOS2 DENDRITES ON SIO2/SI SUBSTRATES BY METAL ORGANIC CHEMICAL VAPOR DEPOSITION

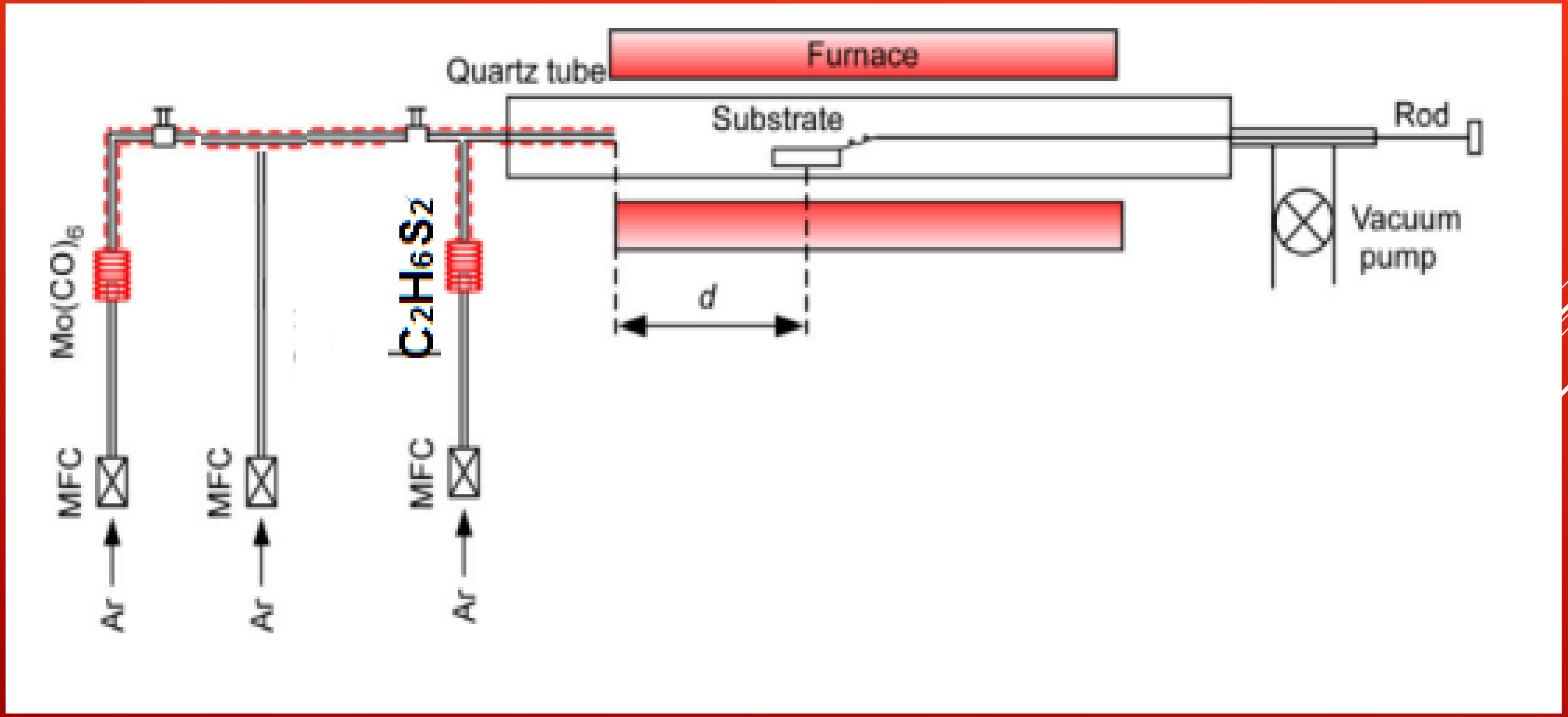
Yossef khattab and S.E .Alexandrov



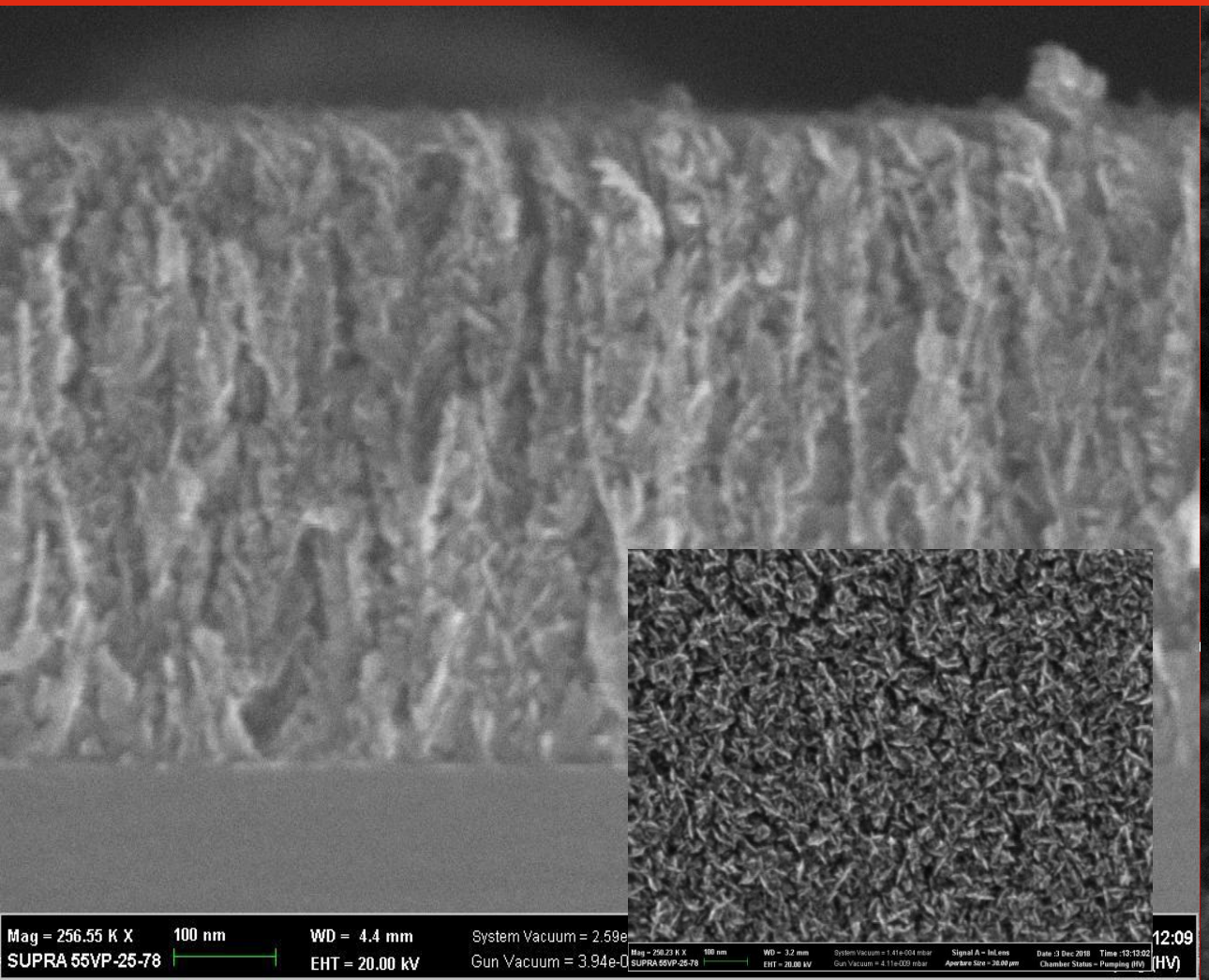


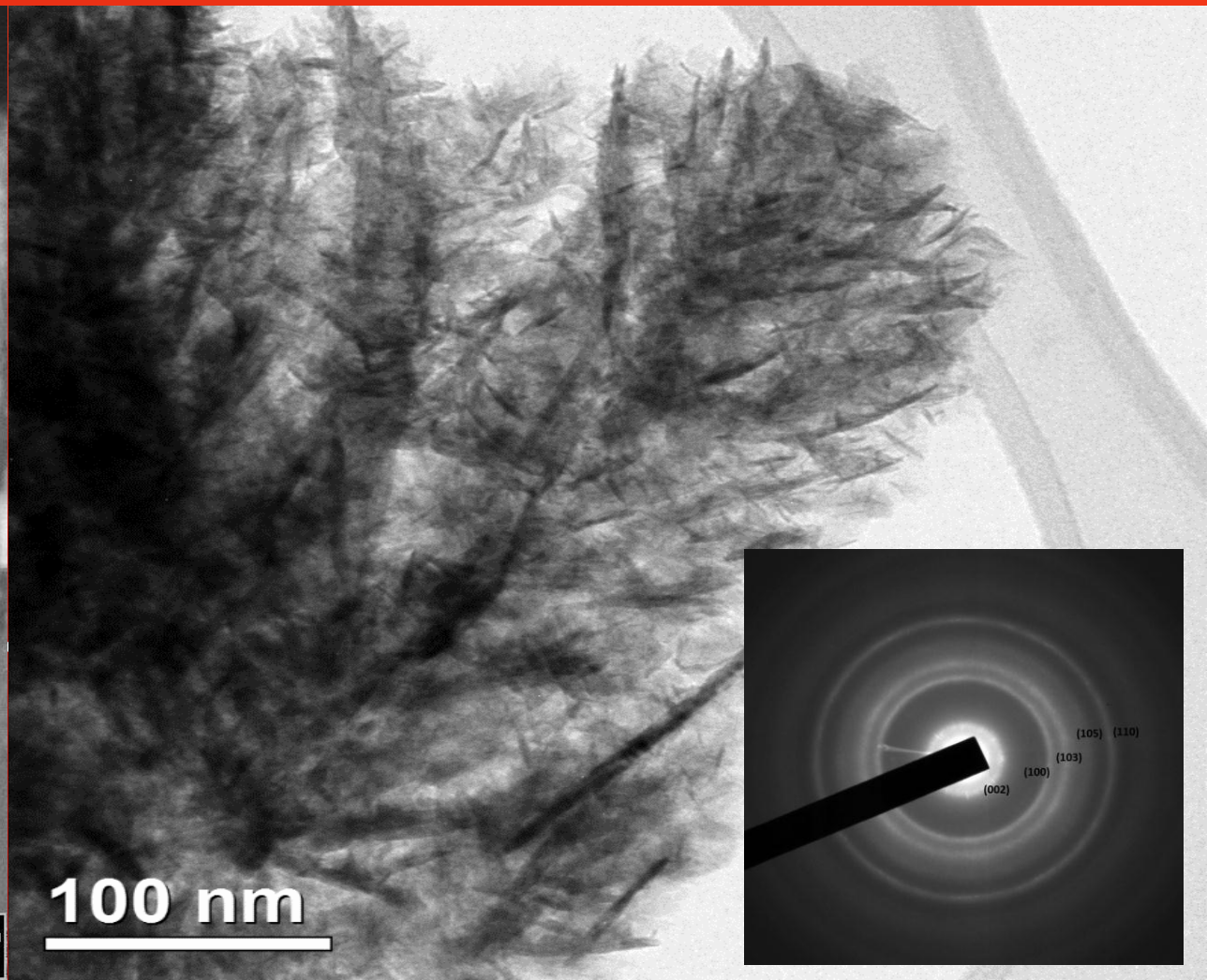
- molybdenum disulfide has a structure described as a succession of a package consisting of two atomic planes of sulfur, between them plane formed by the molybdenum atoms[1].
- band structure of MoS_2 change from an indirect band gap to a direct one when decreasing its thickness from bulk to a single layer , also band gap depend on number of layers in sheets from 1.9 eV for monolayer to 1.3 eV in bulk[1].
- MoS2 has diverse range of application from photo-catalyst and energy applications to nano-electronics and optoelectronics[3]
- The horizontally aligned MoS2 layers have more elevated basal surfaces which are desirable for transistors, microelectronics and photoelectric devices. Whereas, the vertically aligned MoS2 layers where the edge sites are facing upward, the high-density dangling bond sites possessing enormous exhibited d-orbital electrons , Beside of higher aspect ratio[2]
- Vertical nanosheets recently got huge interest for energy applications , growth task still difficult due to lack of full understanding of growth mechanism
- Vertical nanosheets show better performance in many application such as energy and photocatalyst for example HER, supercapacitor , photodetectors[2,3]

- Our Dendrites deposited by MOCVD hot wall horizontal reactor , $Mo(CO)_6$ and $C_2H_6S_2$ as precursors and deposition temperature 350° C on various substrate like Si ,SiO_2/Si, quartz.

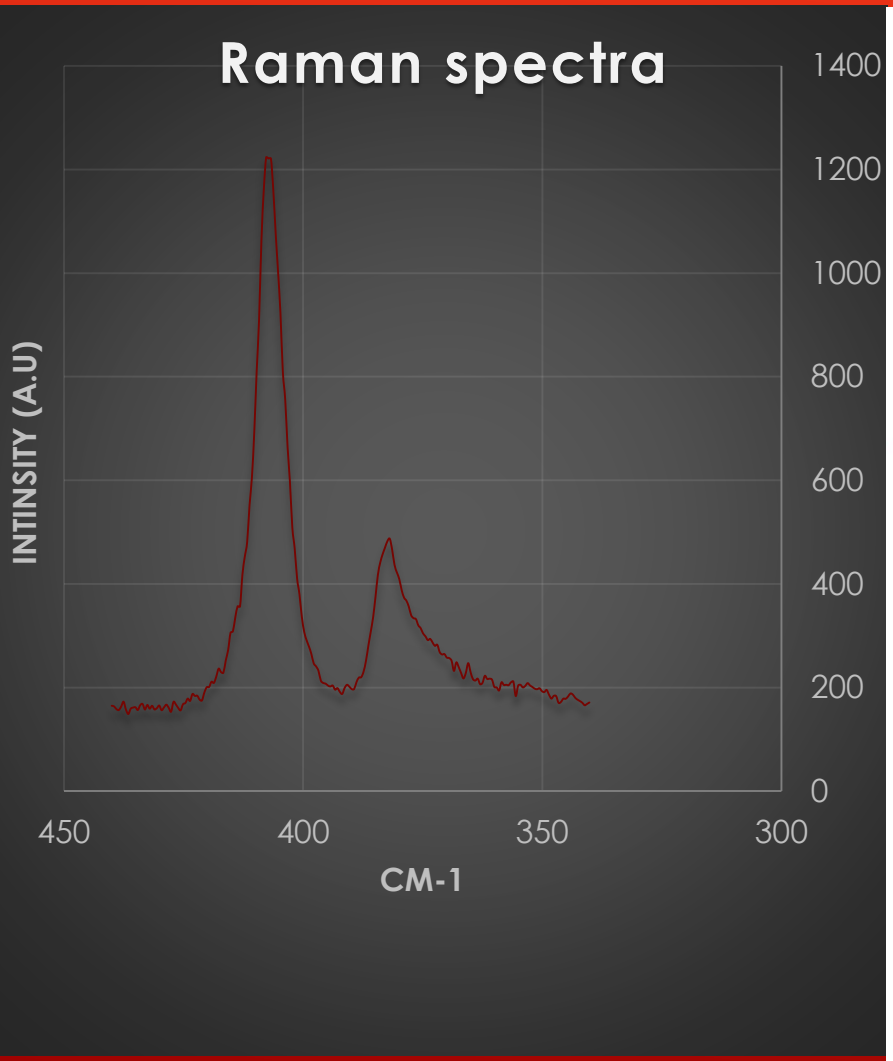


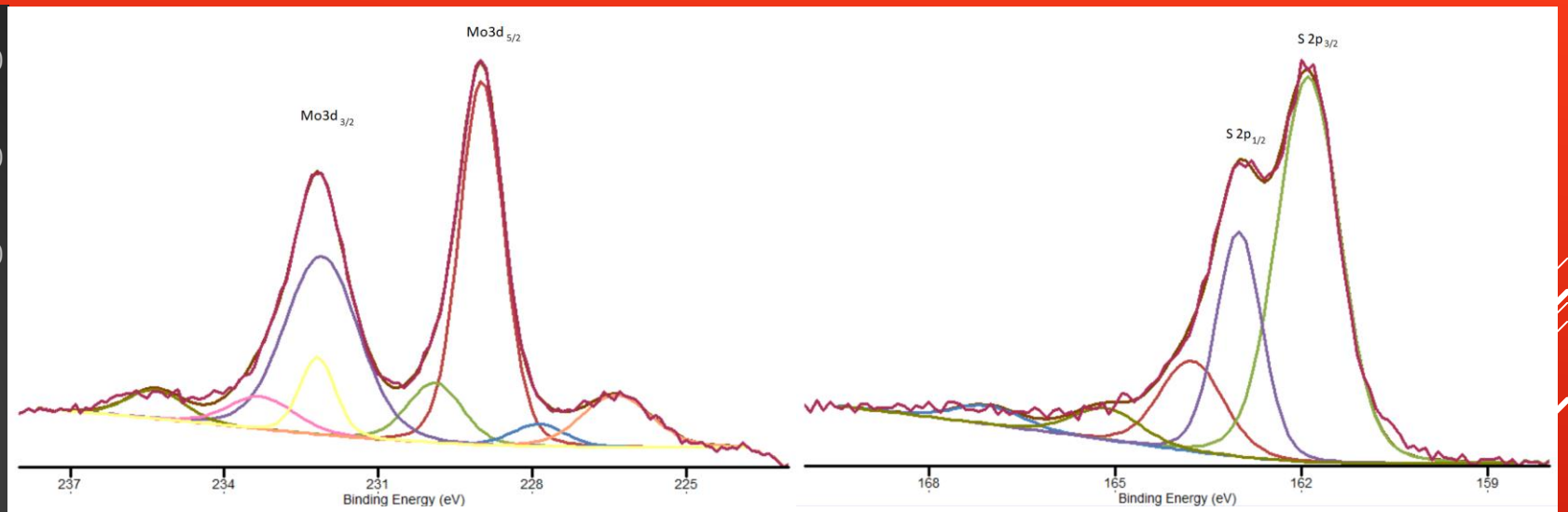
- SEM and TEM show tree-like morphology with vietical orientation
- Electron diffraction confirm 2H-MoS2 ..

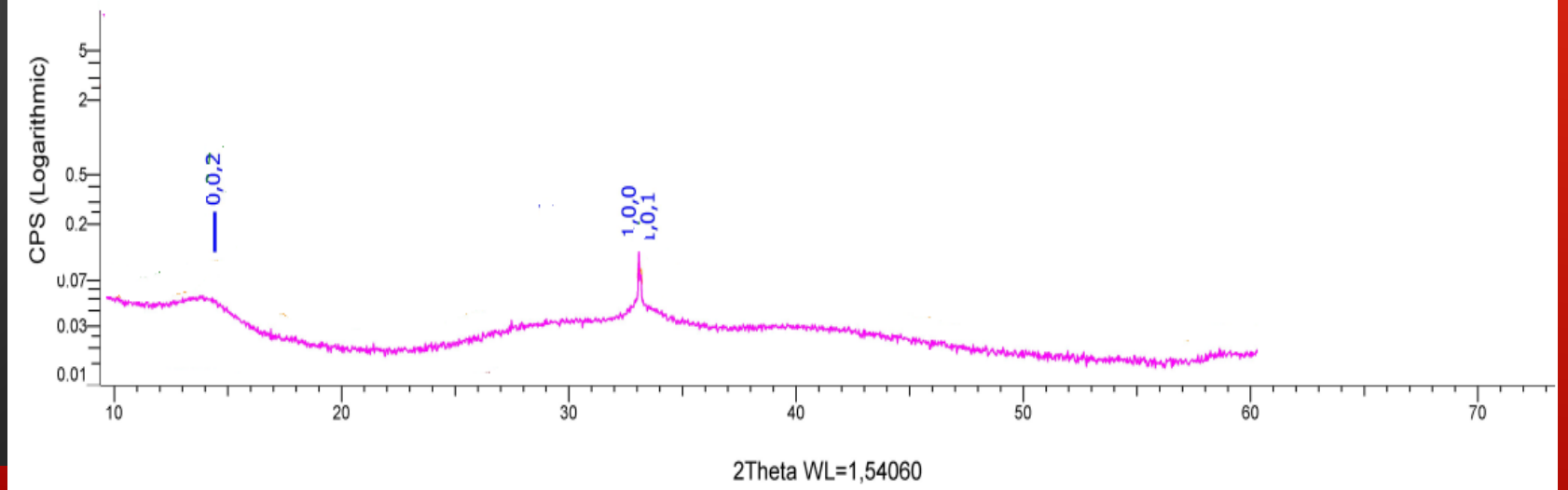




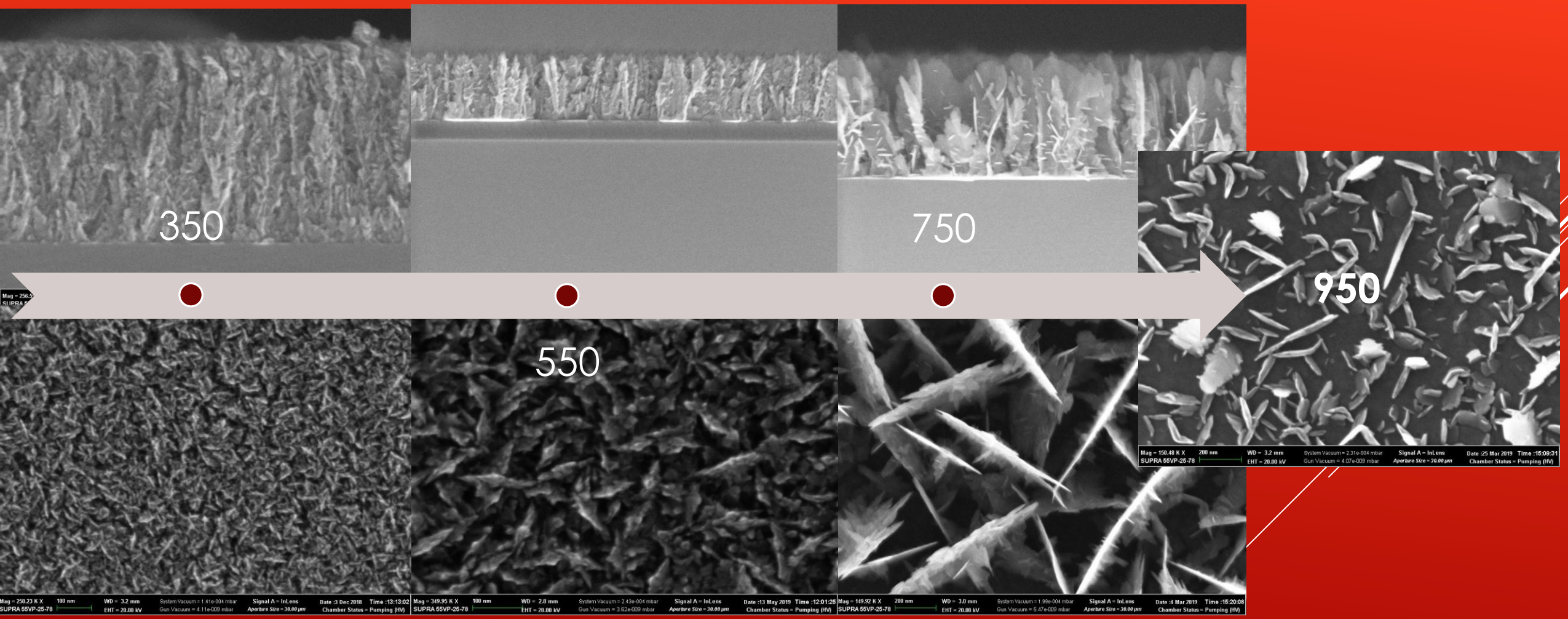
- Stoichiometry and quality of nanosheets investigated by Raman , XPS and XRD.
- Film has crystalline structure as Ag1 and E2g Raman modes show and XRD.



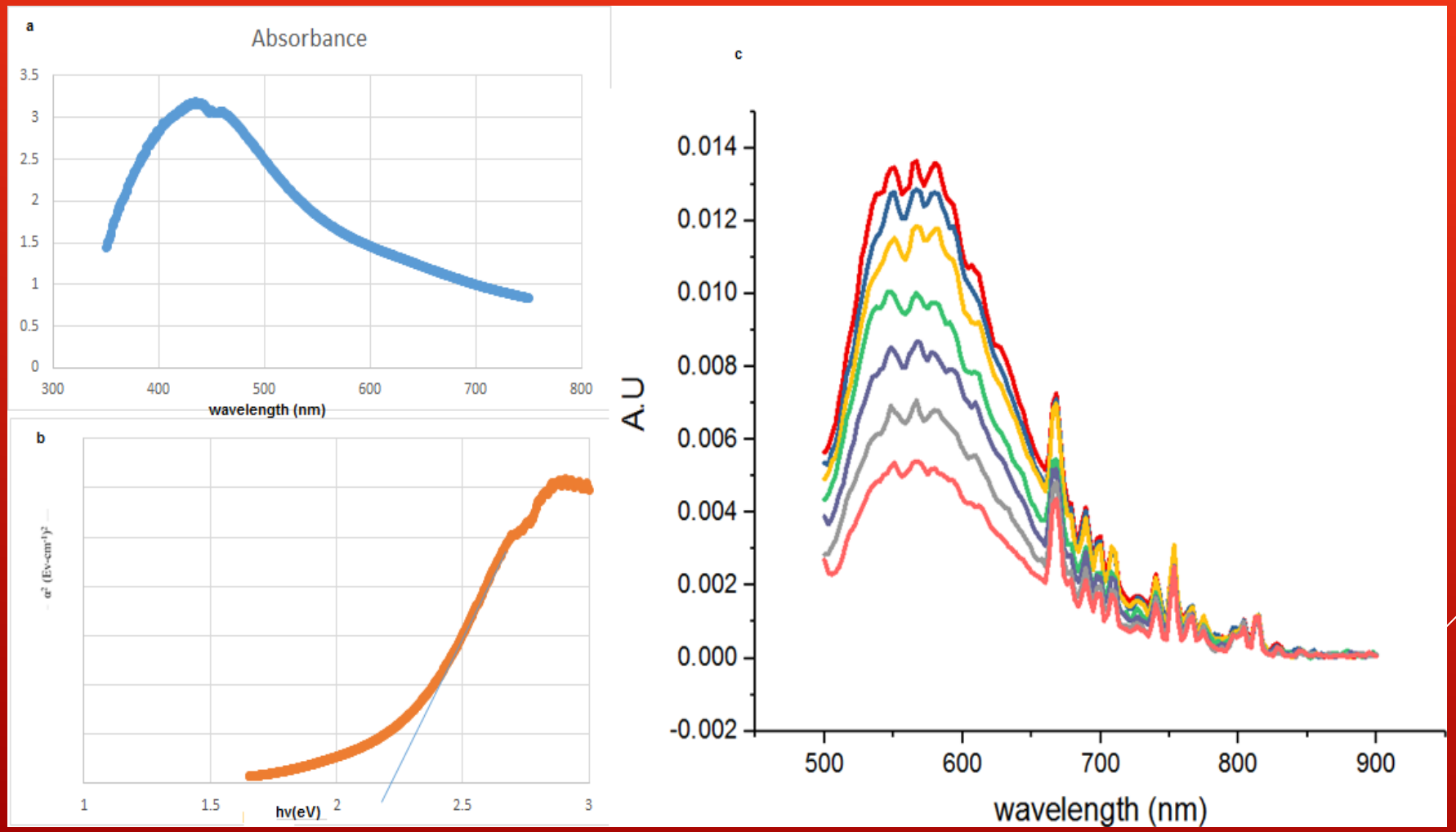




- Increase deposition temperature lead to change from Dendrites at low temperature to vertical walls at very high temperature.
- suggest mechanism is limited diffusion aggregation(LDA)



- Band gap estimated to 2.2 eV ,higher than monolayer
- Photoluminescence cover all visible range of light
- effect of quantum confinement



- **References**

- [1] B. Radisavljevic, A. Radenovic, J. Brivio, V. Giacometti, A. Kis, Single-layer MoS2 transistors. Nat. Nanotechnol. 6, 147–150 (2011).
- [2] S. Li et al., Edge-enriched 2D MoS2 thin films grown by chemical vapor deposition for enhanced catalytic performance. ACS Catal. 7, 877–886 (2017).
- [3] H. Li, J. Wu, Z. Yin, H. Zhang, Preparation and applications of mechanically exfoliated single-layer and multilayer MoS2 and WSe2 nanosheets, Acc. Chem. Res. (2014)