ELECTRON BEAM INTERACTION AND ITS EFFECT ON THE CRYSTALLINE 2H PHASE OF MoS_2

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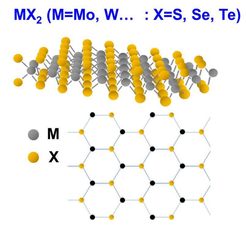
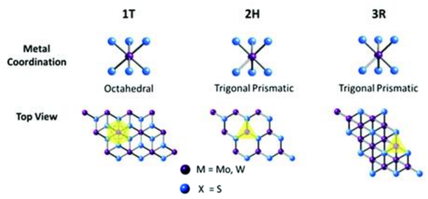
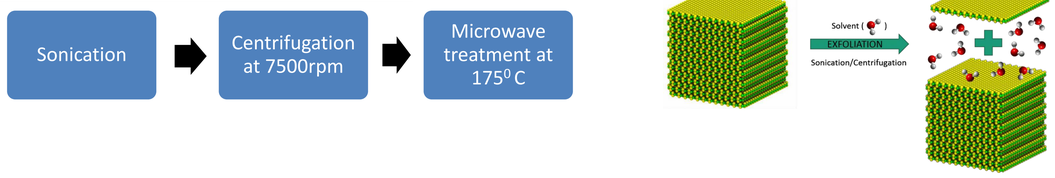
INTRODUCTION:



- TMDs: Materials of the form MX_2 where M is a transition metal and X is any chalcogen
- Layered structure with each layer consisting of 3 atoms (metal atom sandwiched in between two chalcogen atoms)
- Tunable band gap that can undergo a transition from indirect bandgap in bulk materials to direct bandgap in monolayer sheets
- Structural polytypes : 2H , 1T and 3R



EXPERIMENTAL SECTION:



- Sample prepared by Liquid Phase exfoliation of bulk MoS_2 powder
- Initial concentration: 1mg/ml of bulk MoS_2 powder in a mixture of 2, propanol and Distilled water in 2:3 volume ratio
- Microwave (MW) treatment of MoS_2 dispersion for 10 minutes and 30 minutes.

RESULTS AND DISCUSSION:

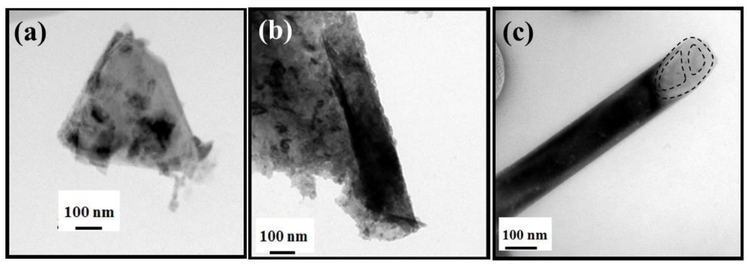


Figure 1. TEM micrographs of the MW treated sample. (a) Shows the flakes present in the sample which rolls and curls as shown in (b) and forms the rod/tube like nanostructures

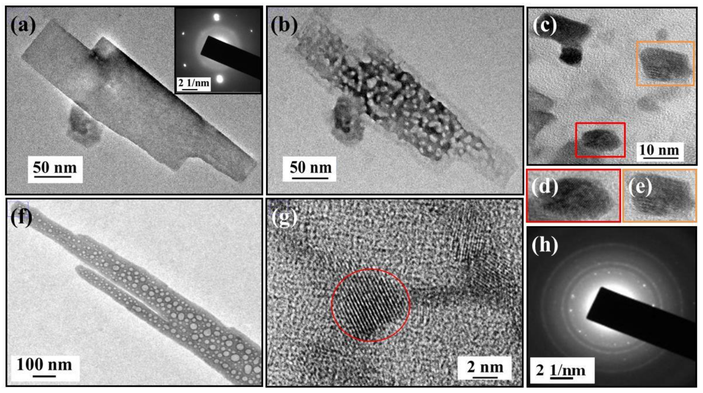


Figure 2. Consecutive TEM images before and after electron beam interaction (10 min MW irradiated sample

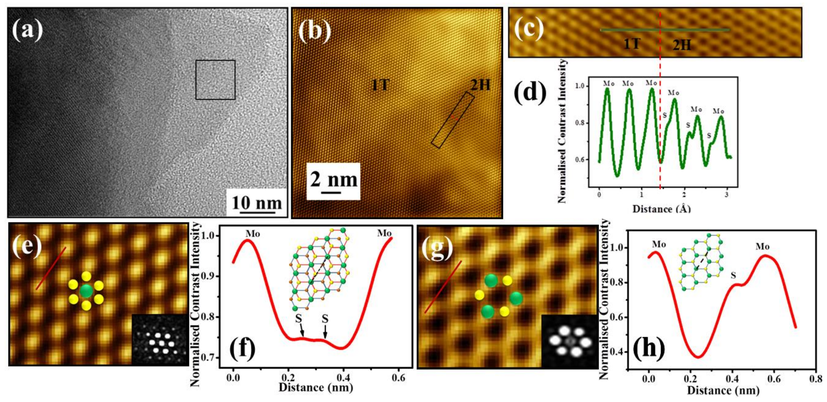


Figure 3. TEM images of 30 min MW treated sample after electron beam interaction. The sample shows the presence of a mixed phase (2H and 1T) with extreme electron beam stability.

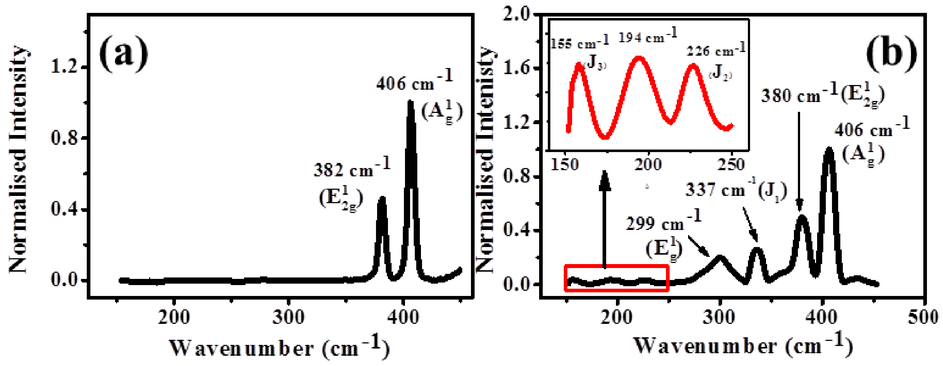


Figure 4. Raman spectra of (a) 10 minute and (b) 30 minute MW treated samples respectively.

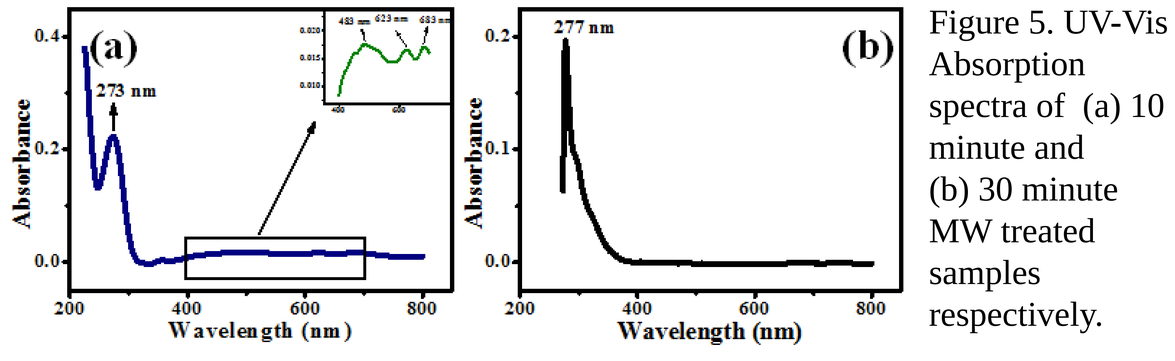


Figure 5. UV-Vis Absorption spectra of (a) 10 minute and (b) 30 minute MW treated samples respectively.

CONCLUSIONS:

- Reasons for structural damage: (i) Radiolysis, (ii) Knock- on, (iii) Heating
- The structural transformation is aided by the microwave energy.
- Compared to 10 min MW (2H phase MoS2) treated sample is found to be extremely vulnerable to electron beam while the 30 min MW treated sample (mixed phase of 1T and 2H MoS_2) is found to be stable towards electron beam (200- 300 keV).

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