# Heat Annealing Influences the Optical Property of 2D $MoS_2$ Nanoparticles

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## Introduction

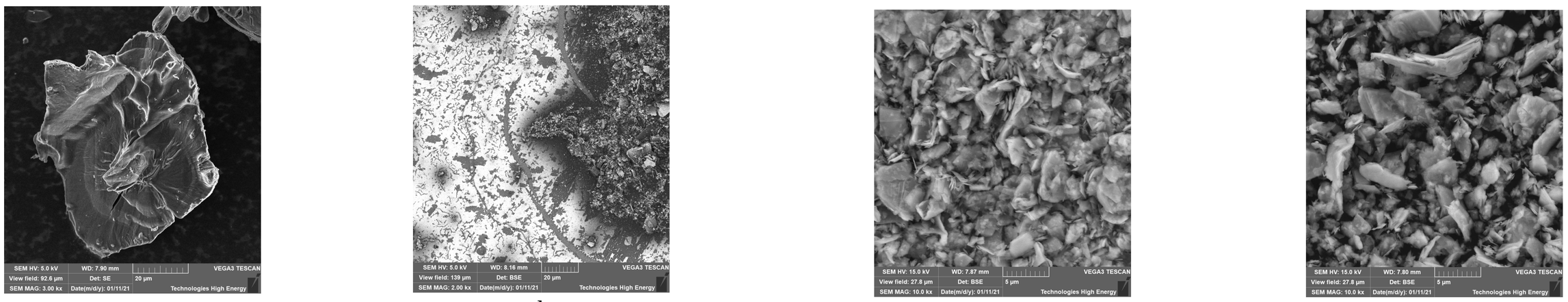
Two dimensional (2D) materials have exhibited extraordinary properties different from those for bulk materials. Among 2D materials, transition metal dichalcogenides (TMDCs) became the good choice for the applications of nanoscaled semiconductor devices and TMDC has become one of the most extensively invested 2D materials for its mechanical, magnetic, electrical and optical properties. The typical example of TMDC is $MoS_2$, which has a unique layered structure similar to graphene, variable band gap, interlayer weak van der Waals forces and flexibility.

## Materials and Methods

We have investigated 2D $MoS_2$ powder and flakes from Sigma Aldrich. $MoS_2$ nanoparticles were annealed in the tube furnace purged and filled with the argon gas (50 Scm) in quartz tube at the temperature of 600$^o$C for one hour.

IR spectra were recorded using an INVENIO-R instrument (Bruker, Germany).Raman spectra were recorded using spectrometer Jobin-Yvon T64000 (Horiba, France) with laser 488 nm, power 0,2 mW for MoS2 powder and 1 mW for MoS2 flakes.

## Results and Dissuasion




a b c d

Fig. 1. Images of unannealed (a) and annealed (b) 2D MoS2 flakes and unannealed (c) and annealed (d) 2D MoS2 powder

In the IR spectra of 2D $MoS_2$ powder, a band of 468 $cm^{-1}$ was detected and its shift to 469 $cm^{-1}$ was observed for annealed 2D $MoS_2$ powder.

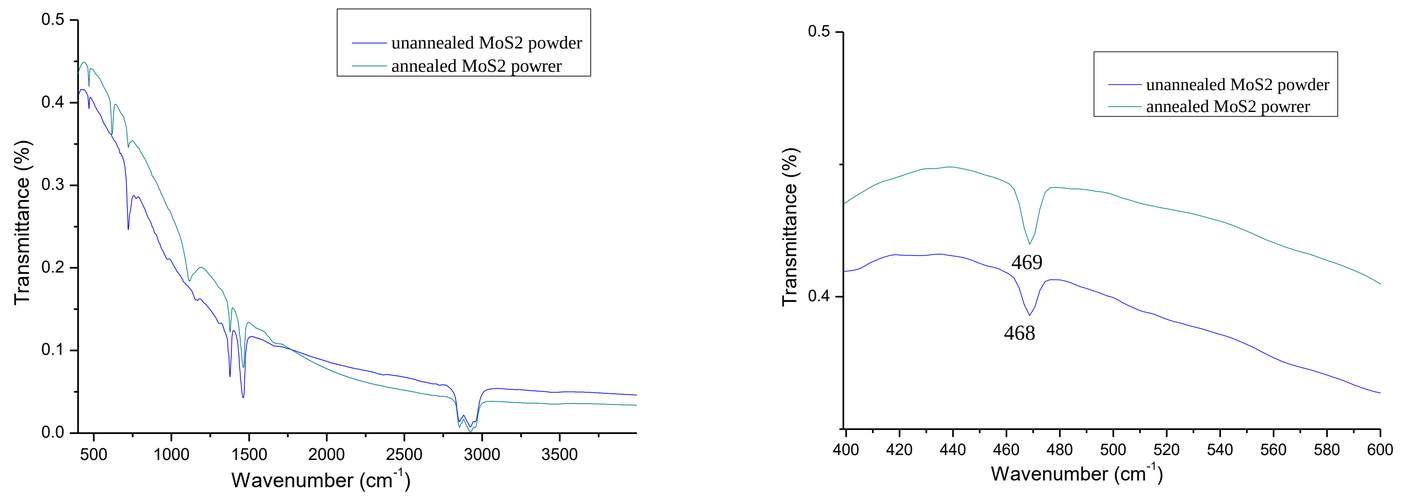



Fig. 2. IR spectra of 2D $MoS_2$ powder

Bands of 150, 189, 285 (1T' single layer), 383, 408, 450, 468, 568, 599 $cm^{-1}$ were observed for Raman spectra of both 2D $MoS_2$ powder and flakes. After annealing of 2D $MoS_2$ powder and flakes 1T' single layer is reduced by 10% and 25% respectively. For flakes the decrease in the number of defects due to annealing was observed.

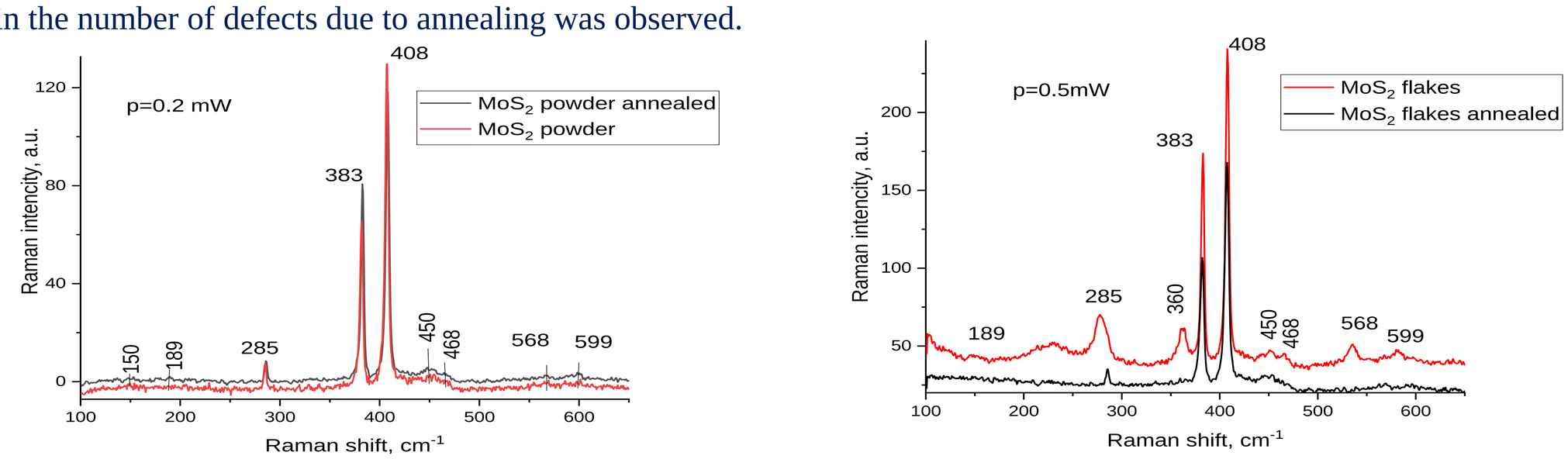



Fig. 3. Raman spectra of 2D $MoS_2$ powder and flakes

## Acknowledgment

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