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A Comparative Analysis of Structural, Morphological and Optical Features of α-MnO_2/SnO_2 and β-MnO_2/SnO_2 Composites

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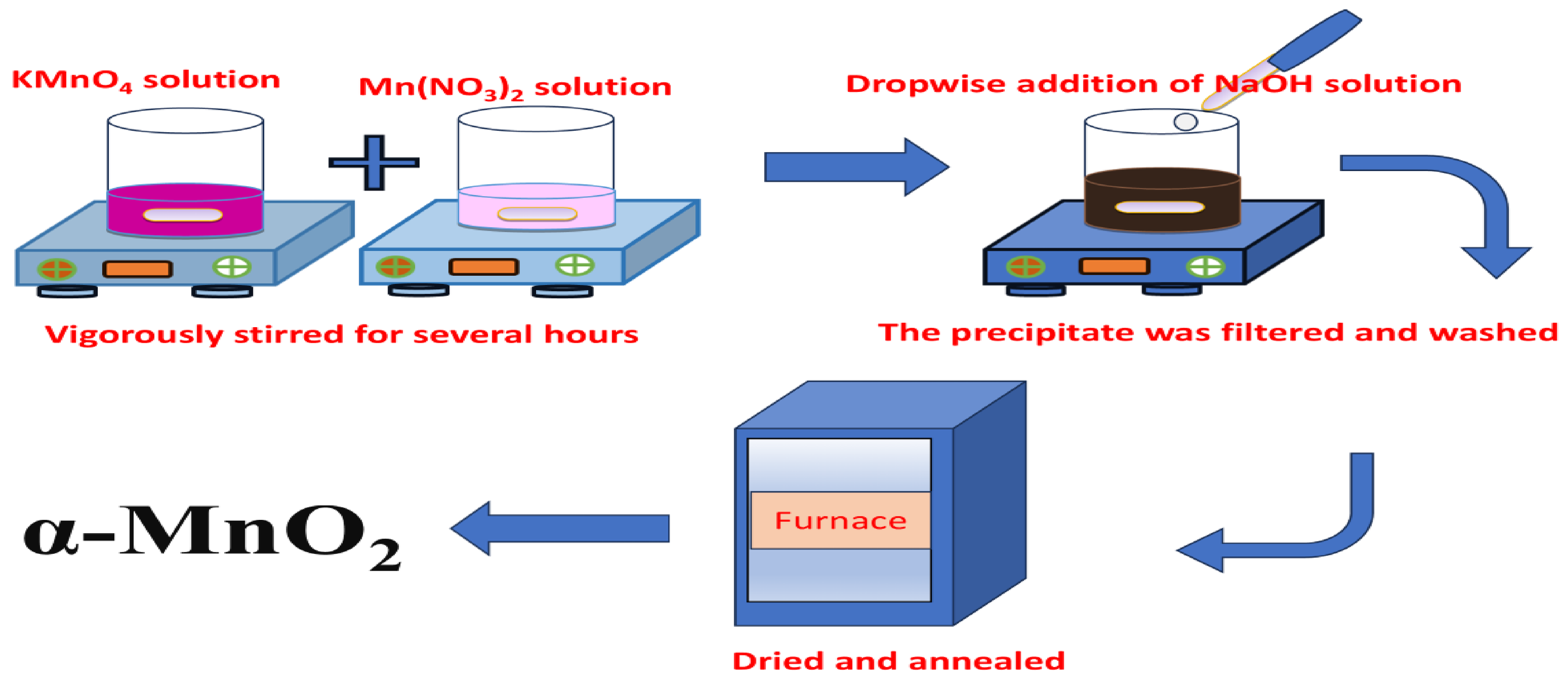
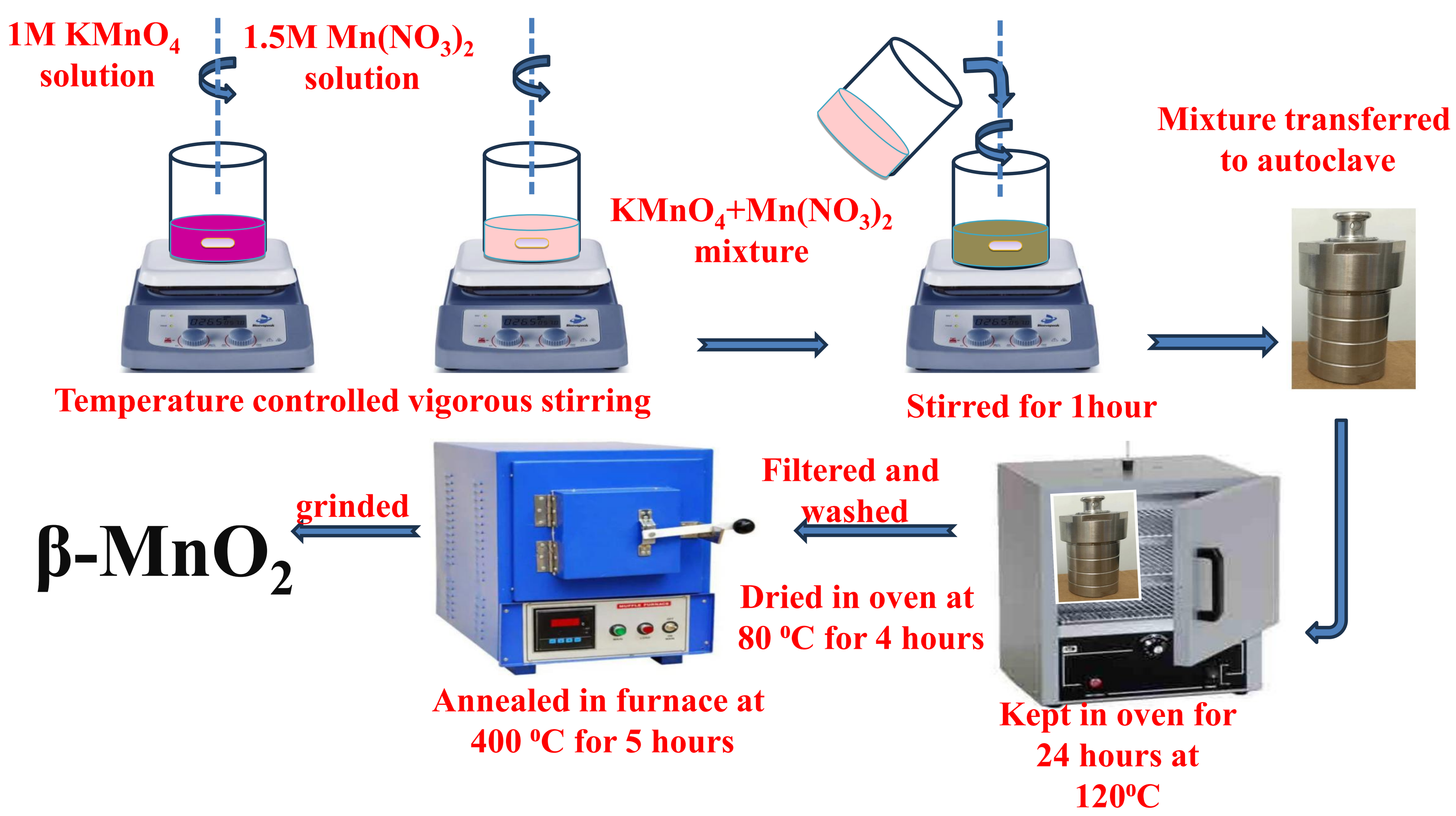
INTRODUCTION & AIM

- Due to rapid industrial growth and ongoing socio-economic activities, our atmosphere has become polluted.
- Maintaining clean air is essential for sustaining human life.
- Nanoparticles have shown great potential in the field of gas sensing as compared to the bulk materials [1].
- Hetero-nanocomposite exhibit superior gas-sensing characteristics [2].
- This study focuses on synthesizing α-MnO_2 and β-MnO_2 based heterostructures combined with SnO_2.
- Thin films produced from these hetero-nanocomposite powders show promise for use as efficient gas-sensing devices.

METHOD



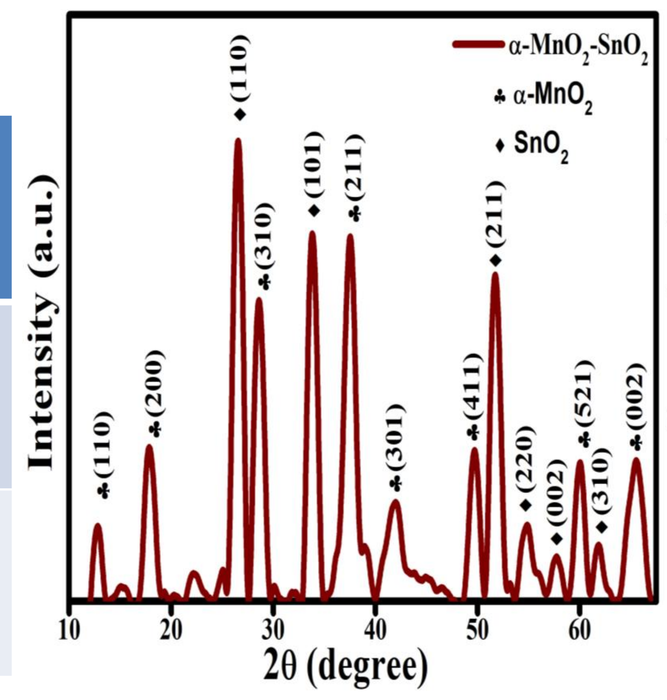


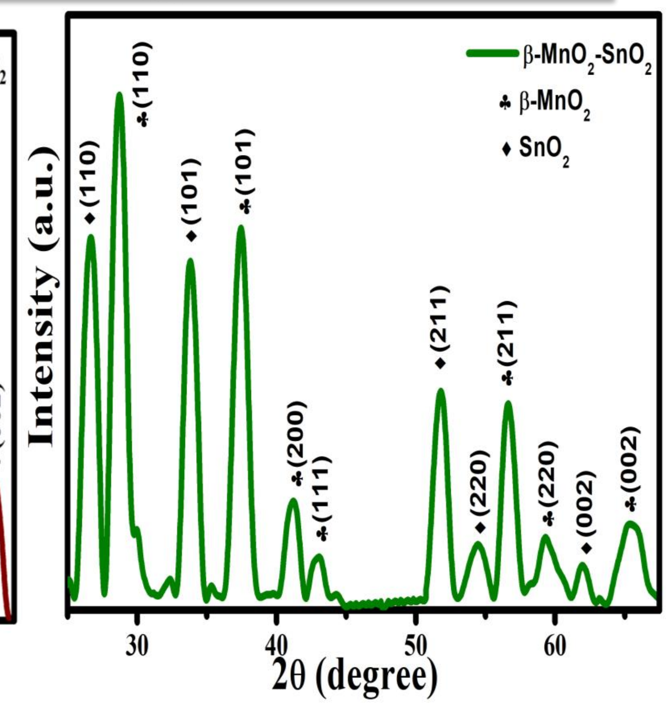
The α-MnO_2 and β-MnO_2 were mechanically mixed with SnO_2 in 1:1 ratio by weight using the agate mortar and pestle. Following which the mixtures were annealed at 400 °C to obtain the nanocomposites

RESULTS & DISCUSSION

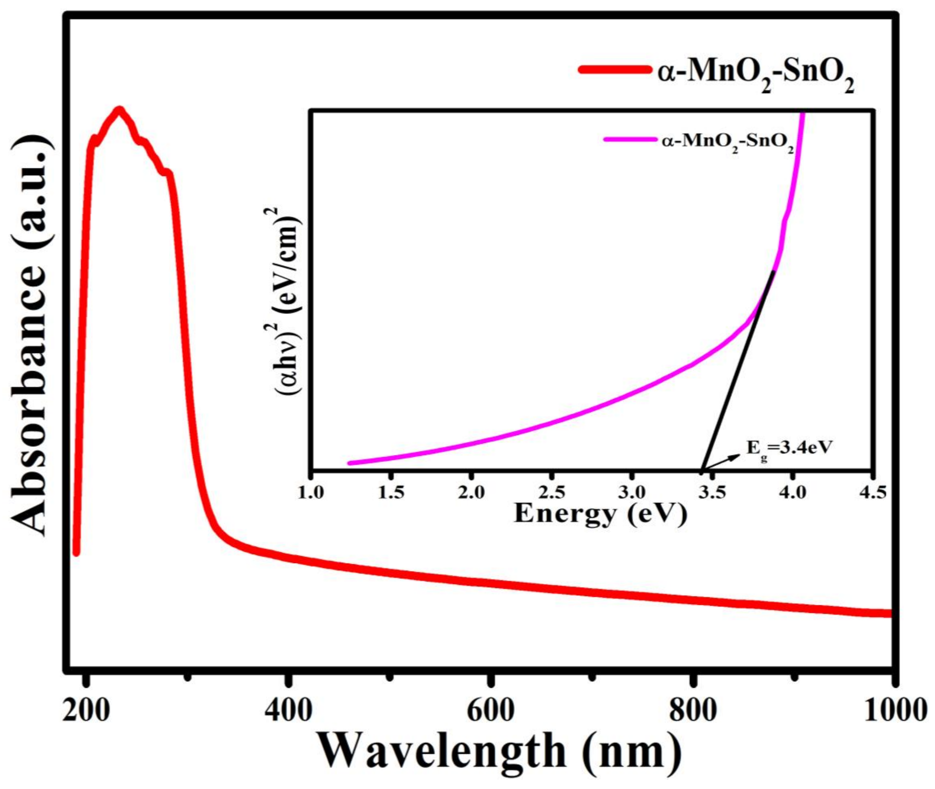
XRD Analysis

Parameters	α-MnO_2-SnO_2	β-MnO_2-SnO_2
Crystallite size D (nm)	19.33	22.58
% Crystallinity	94.75	88.18

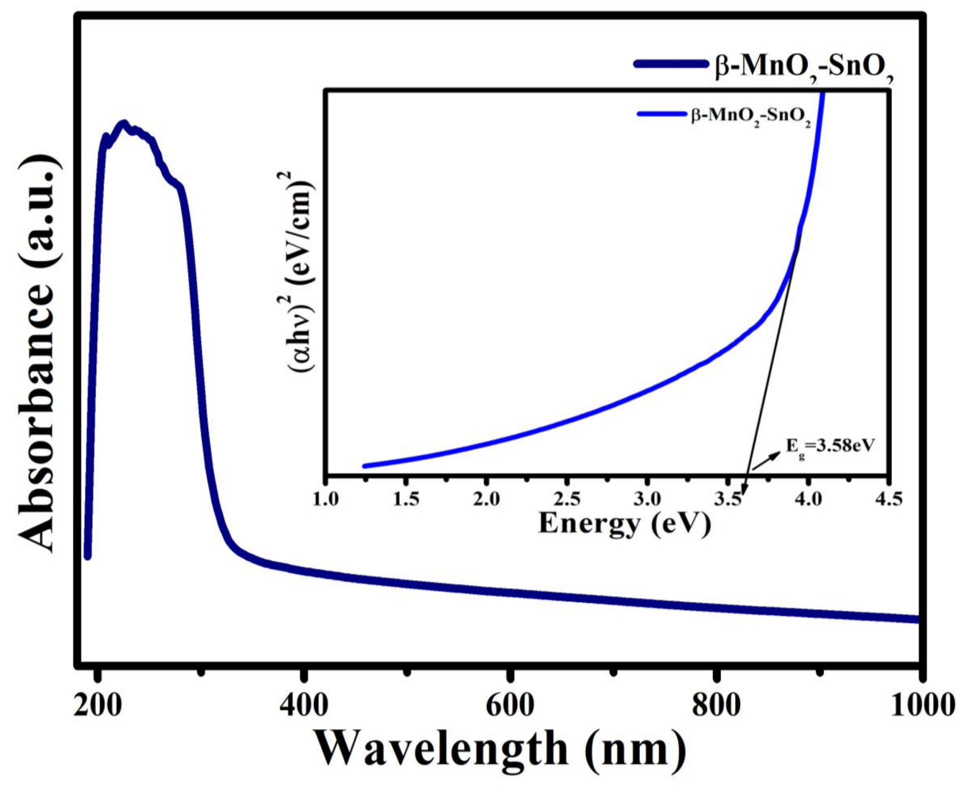




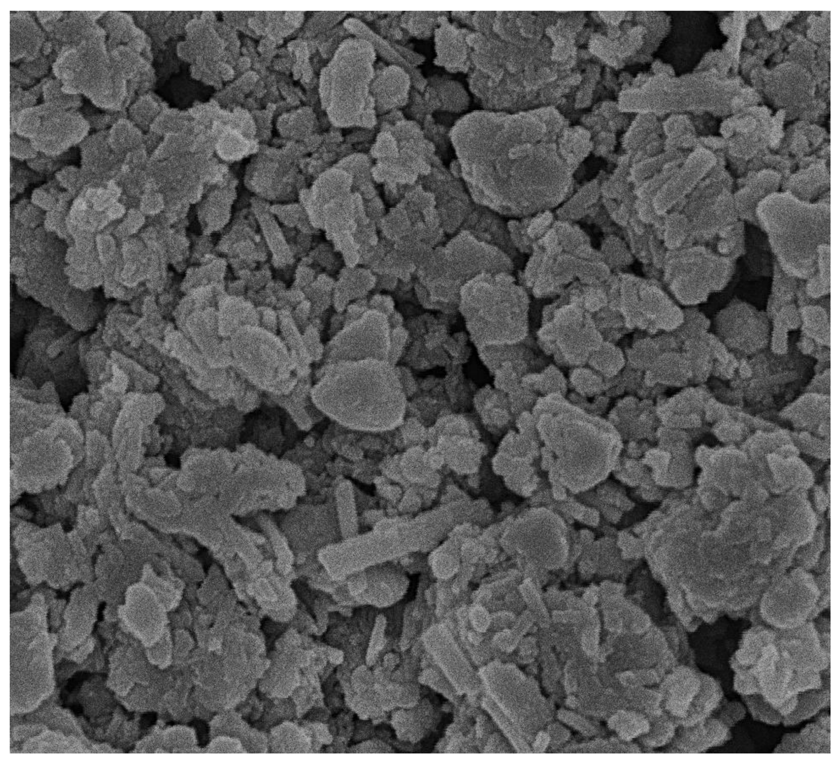
UV-Visible Analysis

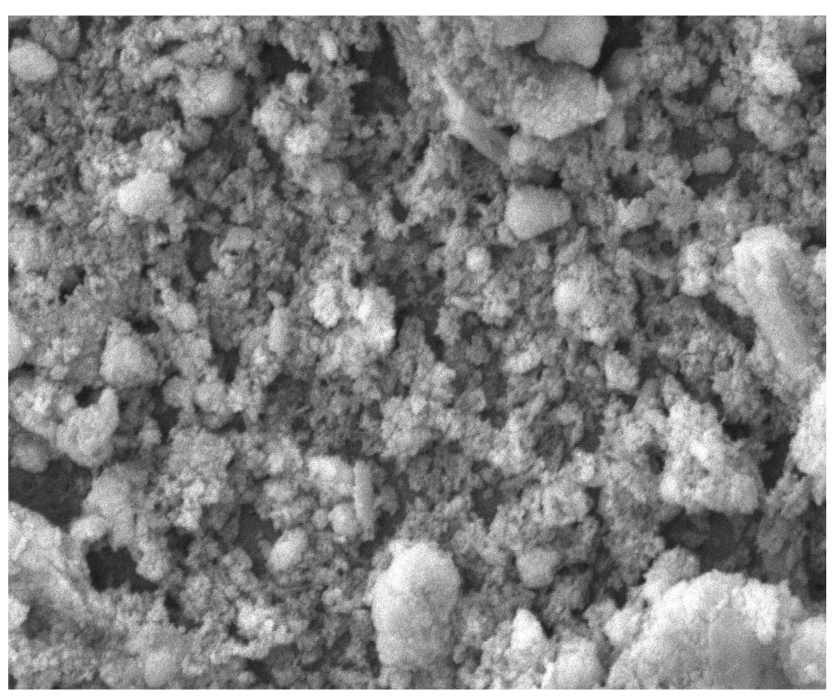


Parameter	α-MnO_2-SnO_2	β-MnO_2-SnO_2
Band Gap (eV)	3.4	3.58

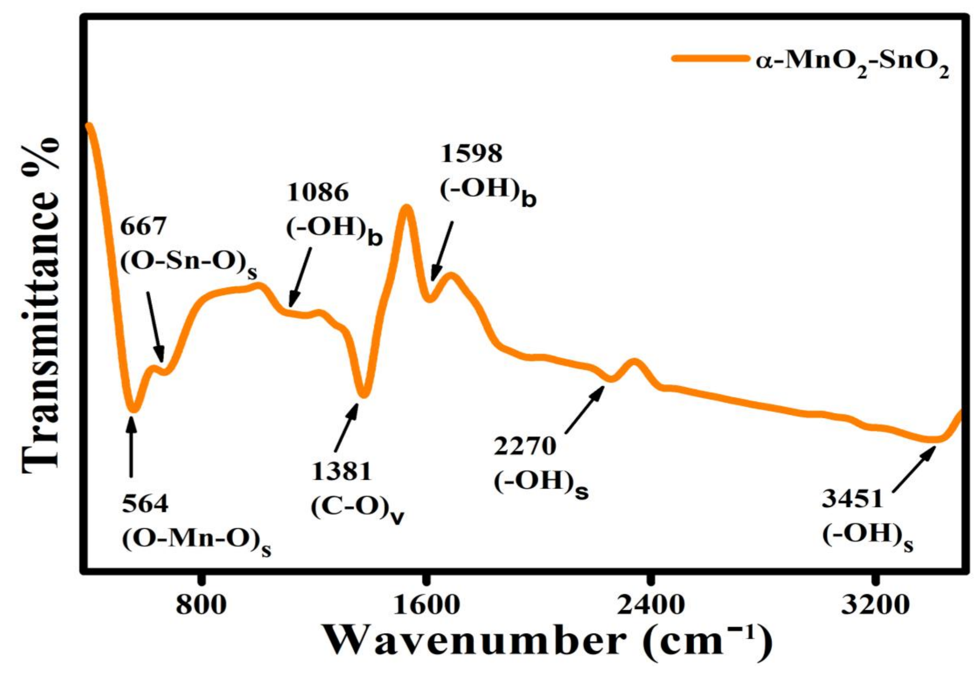


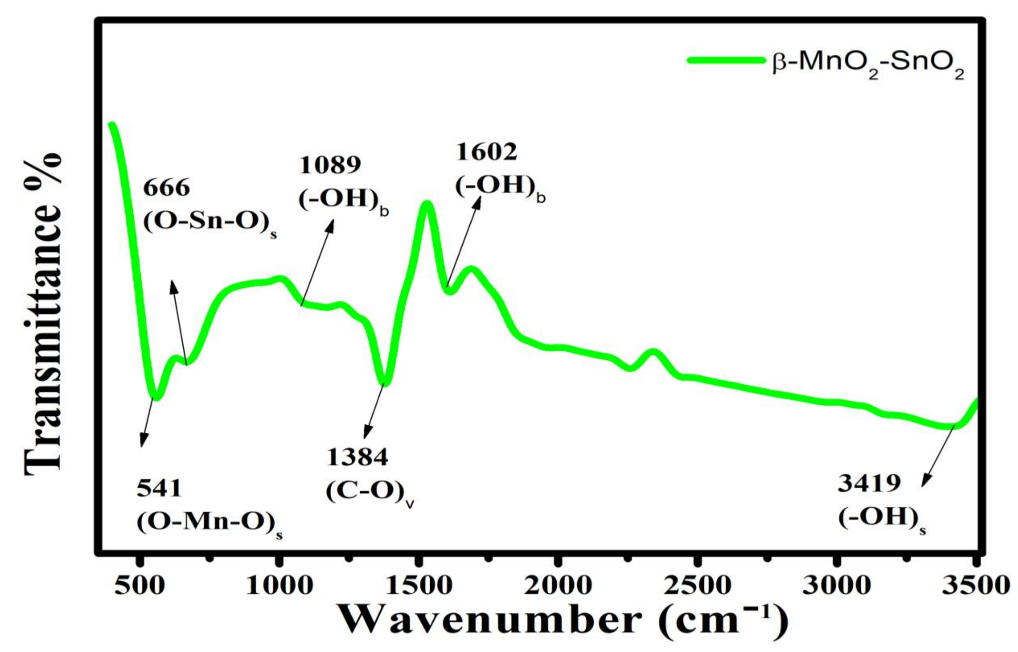
SEM Analysis





FT-IR Analysis





CONCLUSION

- The nanocomposites manifests high crystallinity and small crystallite size.
- Smaller energy band gap of the composites enables enhanced conductivity.
- SEM analysis reveals nanorods of α-MnO_2 and nano-threads of β-MnO_2 mixed with granules of SnO_2.

FUTURE WORK / REFERENCES

[1] Structural and Optical Properties of α-MnO2 Nanowires and β-MnO2 Nanorods N. Rajamanickam et al. Solid-State Physics AIP Conf. Proc. 1591, 267-269 (2014); doi: 10.1063/1.4872568

[2] MnO2-SnO2 Based Liquefied Petroleum Gas Sensing Device for Lowest Explosion Limit Gas Concentration Ajeet Singh et al. ECS Sensors Plus, 2022, 1 025201, doi: 10.1149/ 2754-2726/ac8437