Synthesis, Characterizations and application of Sb_2Se_3 in solar cell with ZnSe as buffer layer

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INTRODUCTION

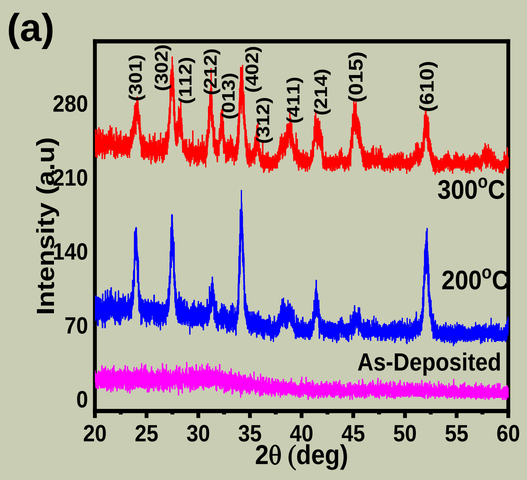
- Sb_2Se_3 is non-toxic and earth abundant material.
- It is a p-type material having a high absorption coefficient (>$10^5 cm^{-1}$) [1] and optimal band gap (~1.2 eV) [2].
- Sb_2Se_3 is a very promising solar absorber material because of its optical and electrical properties.

OBJECTIVE

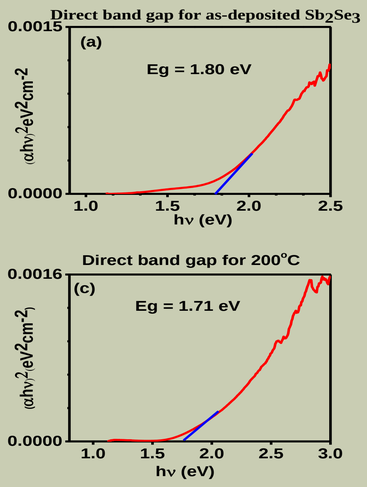
- The films were deposited using thermal vapor deposition technique and are generally amorphous. So, heat treatment was used to enhance its crystallinity. XRD, UV-Vis, and Raman characterizations were done.
- With the help of numerical simulation by SCAPS-1D, the performance of the Sb_2Se_3/ZnSe structure is studied.
- The parameters of p-Sb_2Se_3 such as thickness, and bandgap, obtained experimentally, were used in the numerical study.

EXPERIMENTAL AND NUMERICAL RESULTS

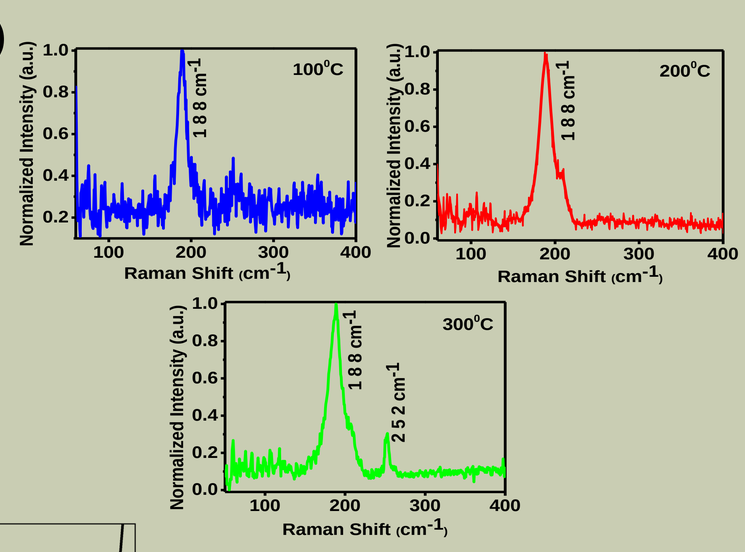
XRD of as-deposited and annealed Sb_2Se_3 films



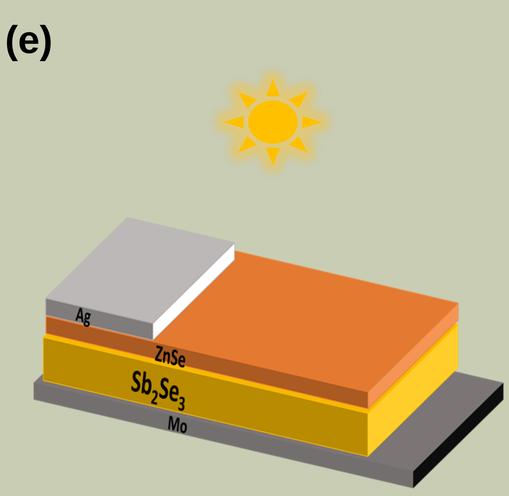
UV-Vis data of as-deposited and annealed Sb_2Se_3 films

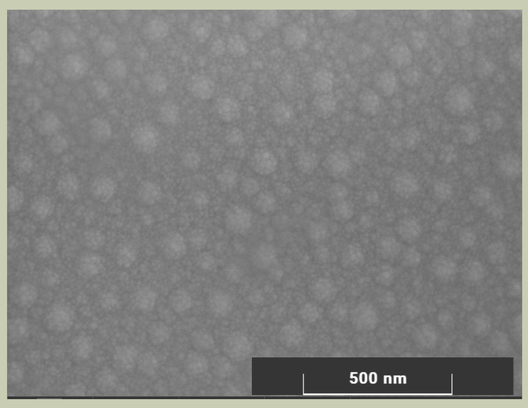


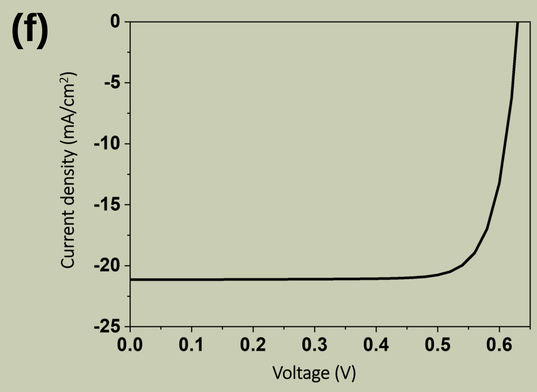
Raman data of as-deposited and annealed Sb_2Se_3 films



Pictorial representation of simulated Sb_2Se_3/ZnSe solar cell







I-V and PV performance of Sb_2Se_3/ZnSe

V_{OC} (V)	J_{SC} (mA/cm^2)	FF (%)	PCE (%)
0.63	21.14	80.81	10.78

CONCLUSION

A direct bandgap of 1.7 eV and thickness of 520 nm is achieved when Sb_2Se_3 film is annealed at 200 ℃. Using these properties of Sb_2Se_3 from experimental data, we simulated the p-Sb_2Se_3/n-ZnSe solar device with the help of SCAPS numerical software. After optimizing all the parameters (ZnSe thickness and bandgap are 60nm and 2.8 eV), the efficiency of 10.78 % is achieved.

REFERENCES

1. Zhou, M., Xia, Z., Zhong, J., Song, H., Liu, X., Yang B., Jhang J., Han J., Chang Y., & Tang, J. (2014). Advanced Energy Material, 1301846.
2. Kamruzzaman, M., Liu, C., Farid UlIslam, A.K.M., (2017). Semiconductors, 1615–1624.