

Antimony selenide(Sb_2Se_3) nanorod Synthesis and properties

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A novel method is described for the preparation of Sb_2Se_3 nano rod in presence of β -cyclodextrin, thin film of which exhibits two conducting states that may find potential application in switching devices.

Importance of semiconducting nanorod:

****exhibits unique electronic, Optical, & mechanical properties due to quantum confinement effect***

****polarized light emission depend on aspect ratio***

****lasing action from ZnO nanorod***

****plastic solar cell from CdSe-P3HT blend***

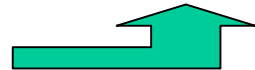
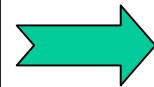
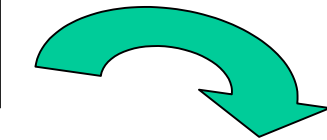
Sb_2Se_3 exhibits good photovoltaic properties and generate high thermoelectric power (TEP) suitable in potential applications in the optical and thermoelectrical cooling devices.

Sample preparation

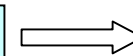
0.12 gm potassium antimony oxide tartrate in 15 ml milipore water

0.12 gm sorbitol in 15ml milipore water

0.283 gm of β -cyclodextrin in 15 ml milipore water



Well stire with NH_4OH pH=10.8



2ml

Sodium selenosulfate solution; Refluxing 2 gms of selenium and 4.83 gms of sodium sulfite in 100 ml of water for 10 hours

After 30 min color becomes yellow



brown



Dark brown



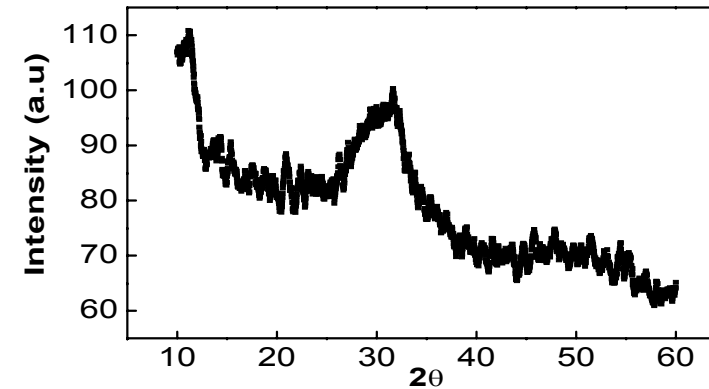
Final product
 Sb_2Se_3
nanorod

Film deposition:

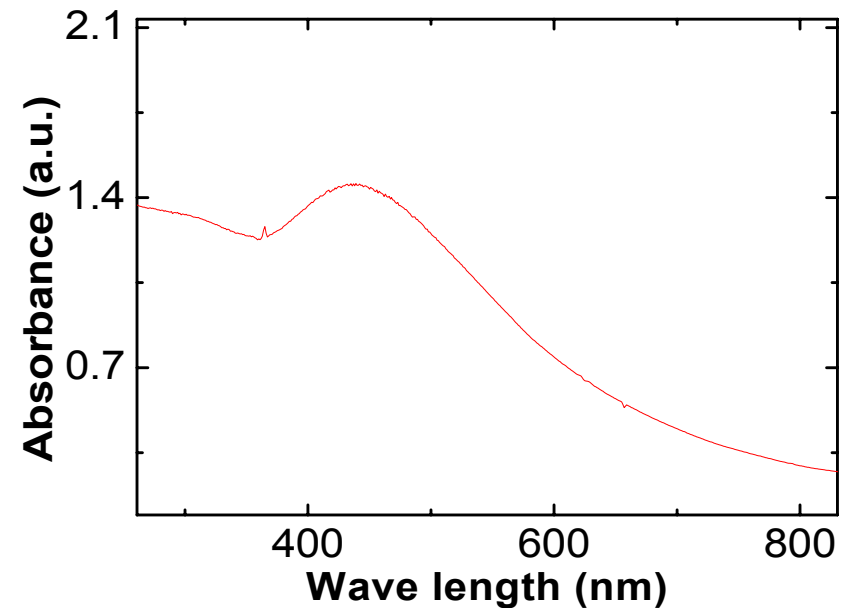
A cleaned ITO coated glass slide was immersed into the reaction bath for film deposition . Optimizing the time of deposition the film was taken out after 8 hours cleaned several times by Millipore water and dried in vacuum at 60°C.

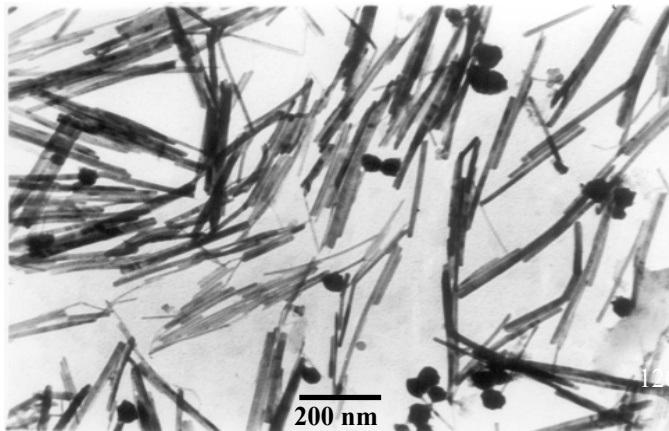
CHARACTERIZATION

XRD spectra shows a broad hump at $2\theta=31.2$, JCPDS data sheet support that maximum intensity at 31.2 for 221 plane

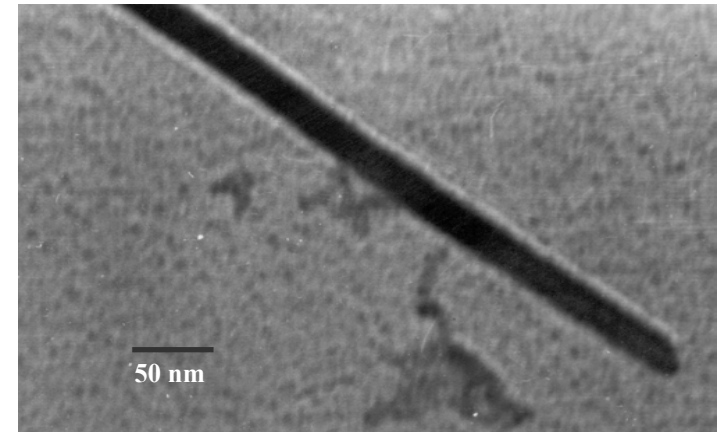


UV-vis absorption spectrum of an aqueous solution of Sb_2Se_3 depicts a peak 437nm corresponding to excitonic energy gap of 2.84 eV





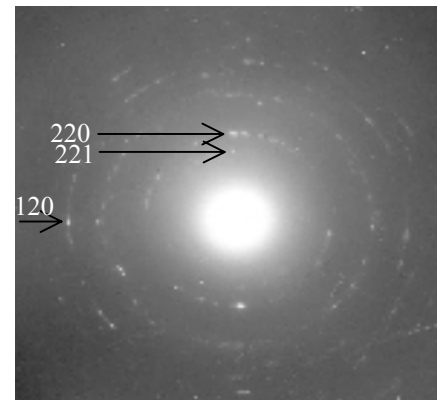
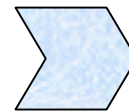
TEM of the Sb_2Se_3 nanorod



the magnified image of a single rod

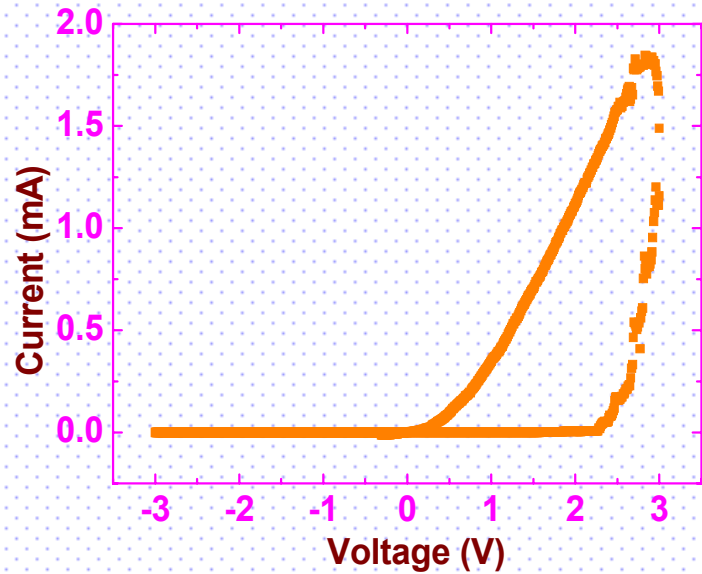
average diameter of the rod measures 15 nm and length in the range of 500 to 800 nm.

SAED pattern of Sb_2Se_3 nano rod shows spot and rings corresponding to 221, 220 and 120 planes (JCPDS data sheet)



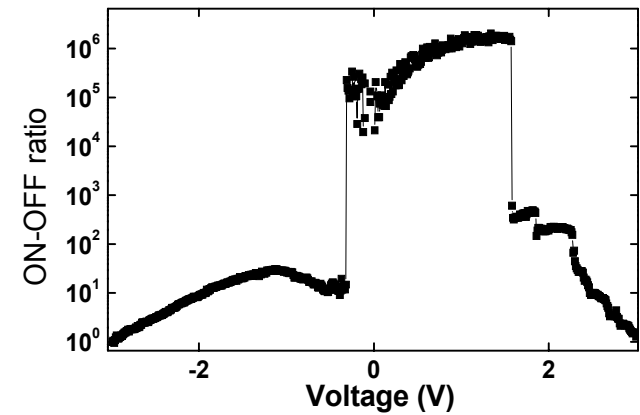
ELECTRICAL CHARECTERIZATION

- ***Device is fabricated by sandwiching thin film of Sb_2Se_3 between ITO and Aluminum.***
- ***In situ deposition of thin film on ITO strip in course of chemical reaction in the beaker***
- ***All the films were dried in the oven at low pressure (10^{-3} torr).***
- ***Aluminum strips were vacuum evaporated on the film to give a device area of 6 mm^2 at 10^{-6} torr.***
- ***I-V characteristic were taken Yokogawa 7651 and picoammeter 486 interfaced with PC, with scan rate 2.5mV/s to 25mV/s .***
- ***Scheme for the I-V characteristic $0V-(+V_{max})-(-V_{max})-(+V_{max})$***



I-V characteristics showing spontaneous switching between the two conducting states in the first quadrant

Plot represent the ratio of currents between the high and the low conducting states.



Conclusions

- ***A successful method is developed for fabrication of Sb_2Se_3 nano rod using β -Cyclodextrin***
- ***Quantum confinement effect: Energy gap of nano rod shifts from reported value of 2 eV for poly crystalline film to 2.85 eV***
- ***In viewing of cavity of β -Cyclodextrin and diameter of the nanorod it is concluded that β -Cyclodextrin does not form any inclusion complex, probably it acts as a structure modifier.***