Temperature dependent absorption spectrum of exfoliated InSe

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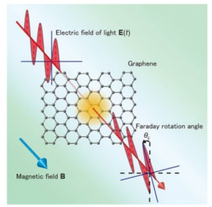
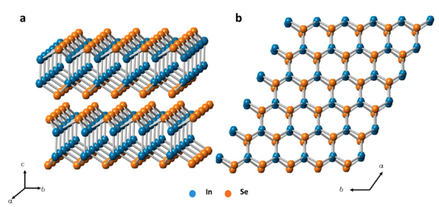
Thin layered materials

Intensive studies of thin layered materials (e.g. graphene) have revealed unexplored phenomena including quantum Hall effect.



Optical quantum Hall effect[1]

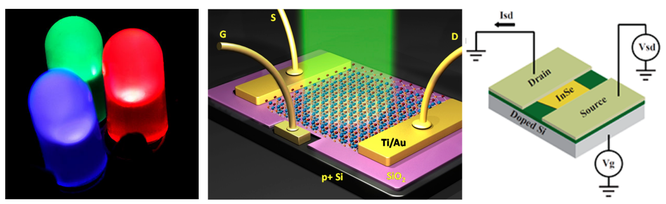


Crystal structure of γ-InSe[2]

Indium monoselenide (InSe)

- A layered semiconductors applicable for transparent, flexible, and energy-efficient opto-electronic devices (memory[3]/FET[4]/detector[5]/LED/ soler cell) and thermo-electric devices[6].

- The material properties (band structure, exciton energy) can be tuned by controlling the number of layers[7].



Applications: LED (from wikipedia.org), memory[3] and field effect transistor (FET)[4]

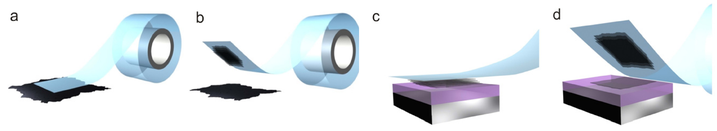
Objective of our work

- To controll the sample thickness of InSe based on mechanical exfoliation (scotch tape method).

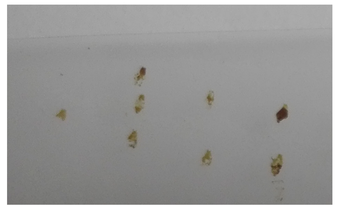
- To investigate optical properties of the exfoliated sample.

Sample preparation

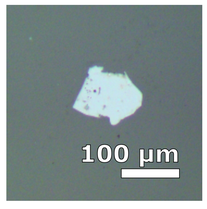
Thin flakes of InSe was made on a quartz substrate by mechanical exfoliation with scotch tape.



Mechanical exfoliation[8]



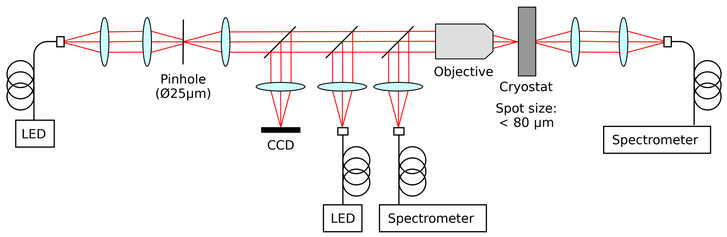
Exfoliated sample on scotch tape



Optical micrograph of sample flake

Experiment

Transmission spectrum was measured with changing temperature from 80 to 300 K.



Schematic diagram of optical experiment

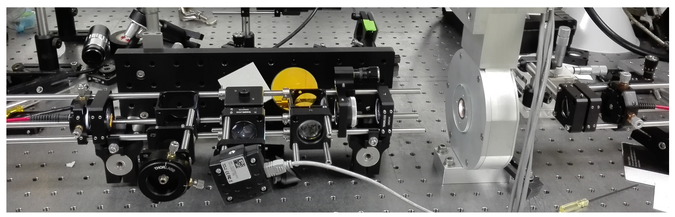
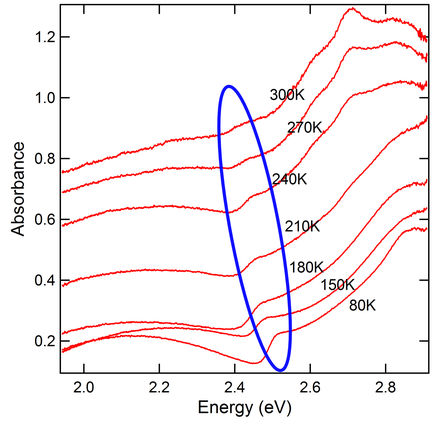


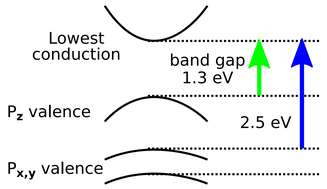
Image of setup

Result & Discussion



Features at 300 K around 2.5 eV became significant and shifted to higher energy as temperature decreased.

temperature dependent absorbance



We attribute measured features to the direct transition from a $P_{x,y}$ valence band to the lowest conduction band, by observing its temperature dependence.

Electric bands of InSe[9]

Conclusion

- We successfully exfoliated a thin InSe sample.

- We made an optical setup to measure transmission spectrum of a small (~80 μm) flake.

- We observed the excitation from the second highest valence band to the lowest conduction band.

References

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