Photoluminescence Imaging of WSe_2 monolayer

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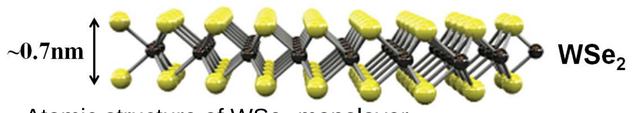
Abstract

- Photoluminescence is the emission of light from a material due to photoexcitation. A setup has been constructed to measure the amount of photoluminescence found in a sample of Tungsten Diselenide (WSe_2). WSe_2 is used because it can be injected with electrons and holes. When the electrons and holes recombine, the electrons emit their energy as light, which is then projected onto a spectrometer that will create a graph which will display how much photoluminescence is produced by the sample. Its monolayers are useful because they display bright photoluminescence and can enhance optoelectronic applications.



Atomic structure of WSe_2 monolayer

Background

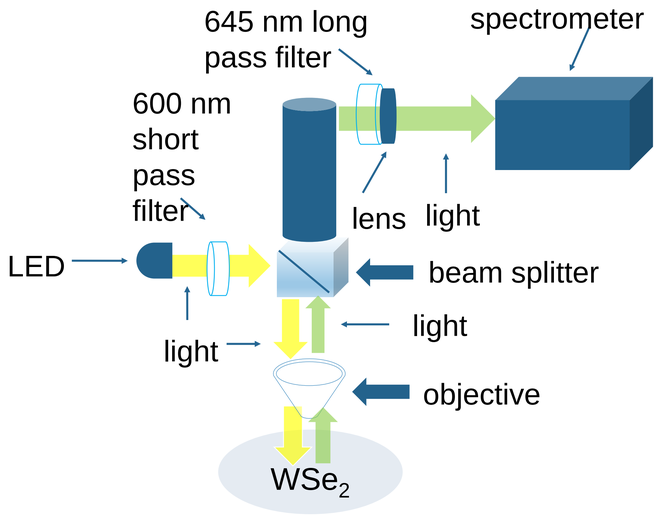
- Photoluminescence measurements can be used for bandgap determination, comparing efficiency levels of different samples, creating a spatial map to see how different areas on the sample compare, impurity levels, characterizing optical quality, defect detection, and recombination mechanisms.
- This setup in particular is helpful with comparing results with that of using a laser.

Objectives

- Determine amount of photoluminescence produced by WSe_2.
- Give an alternative to measuring photoluminescence using a laser.

Methods

- LED is used as a the light source
- When the light from the LED goes through the filter, only the light that has a wavelength of 600 nm or lower will pass through to the beam splitter.
- After hitting the beam splitter, the light that is directed downwards will pass through the objective onto the sample.



- Electrons and holes on the sample will recombine with one another and produce light which will travel upwards.
- The light will then travel through a 645 nm long pass filter which will only allow the light with wavelengths of 645 nm or higher to pass through.
- The light that passes through the filter will then be focused by a lens and directed onto the spectrometer to measure photoluminescence.

Acknowledgements

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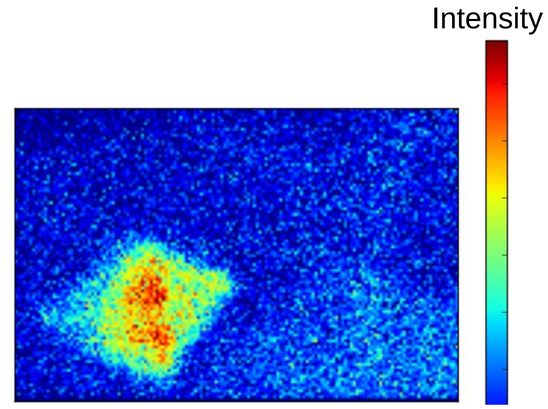
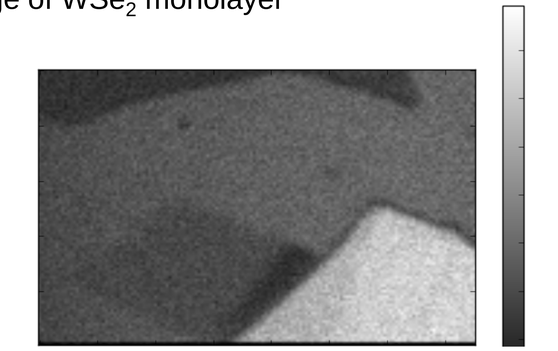
Results

Photoluminescence image of WSe_2 monolayer



Optical image of WSe_2 monolayer



Conclusions

The photoluminescence image of the WSe_2 monolayer shows which sections of the monolayer that have the most intensity. The sections with the red, yellow, and light blue colors indicate that the most intensity can be found there. This information can be used to check for the efficiency of the monolayer, characterizing optical quality, and because Prof. Ming's group's focus is optical slot antennas, it can be used to determine if the antenna region is brighter than other regions.