

## Introduction, Objectives, & Impact of Professor's Research

In Professor Wang's lab, we are working with two-dimensional materials, specifically black phosphorus and applying them to electronics and optoelectronics trying to make them energy efficient. Using few-layer black phosphorus crystals, we fabricate field-effect transistors and experiment with the new devices to see the impact black phosphorus could have on future technologies. Also, the impact that black phosphorus has is immense as it is a favorable material that allows machines to have high performance and for developing mid-infrared polarizers and polarization sensors.

## Measurements and Results

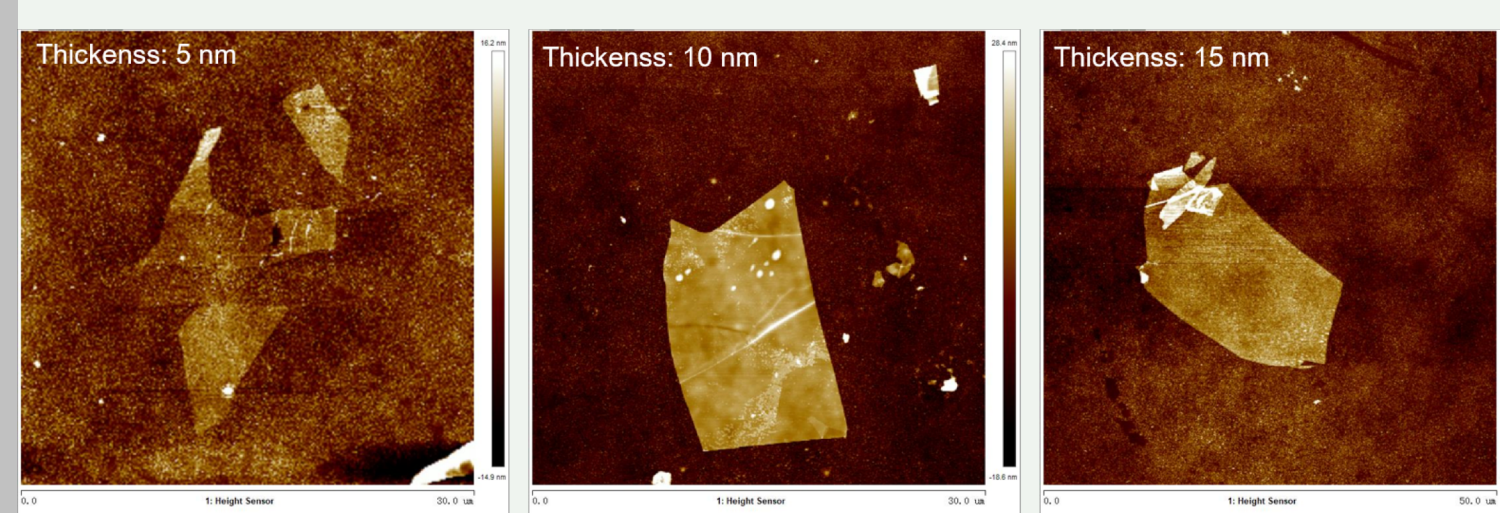


Figure 2. AFM image of exfoliated few layered BP crystal with different thicknesses.

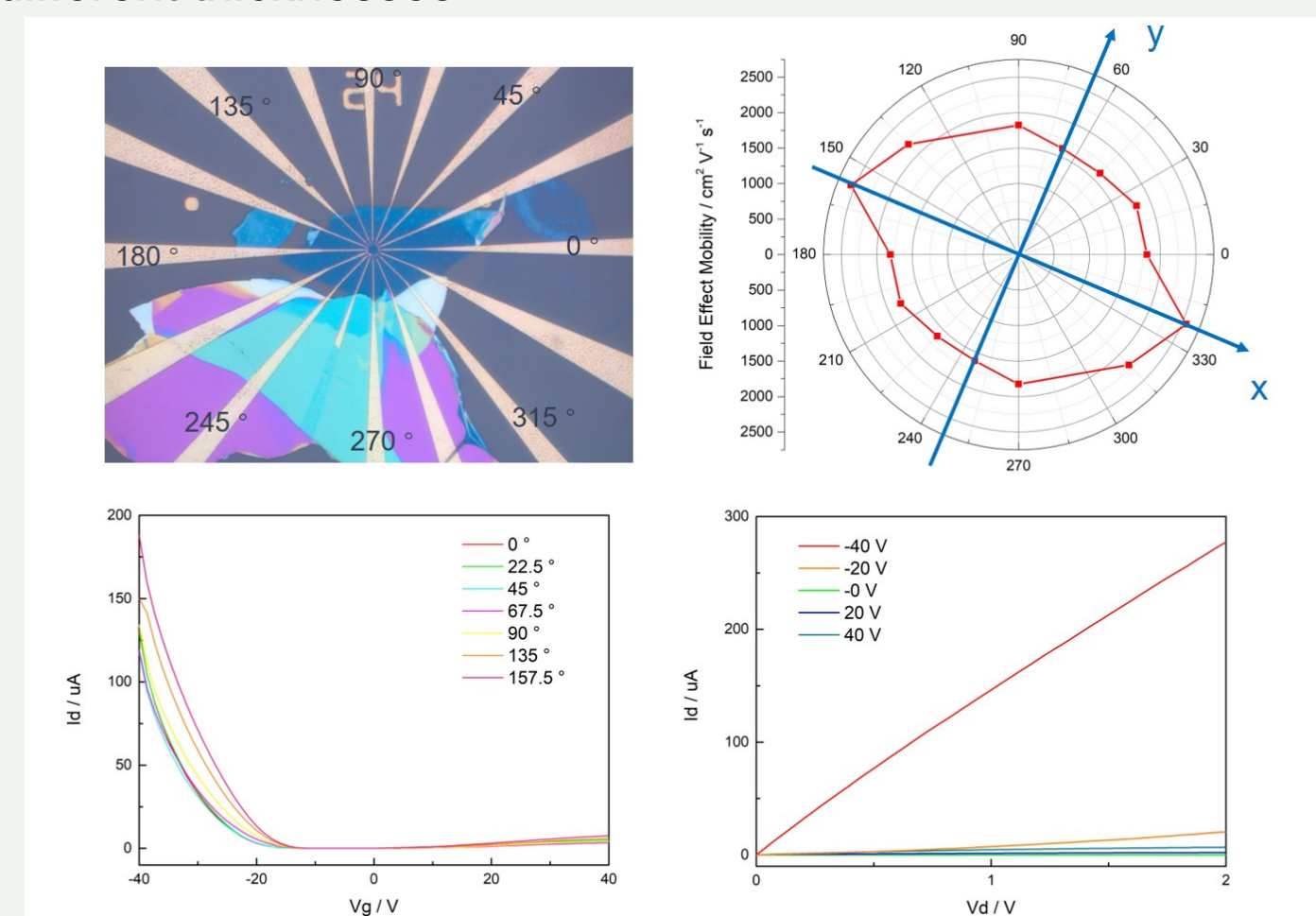


Figure 3. We fabricated the device for polarization measurement. We measure a mobility of 2559 and 1617  $\text{cm}^2\text{V}^{-1}\text{s}^{-1}$  along the light (x) and heavy (y) effective mass directions. BP along x direction exhibits an on-off current ratio exceeding 105.

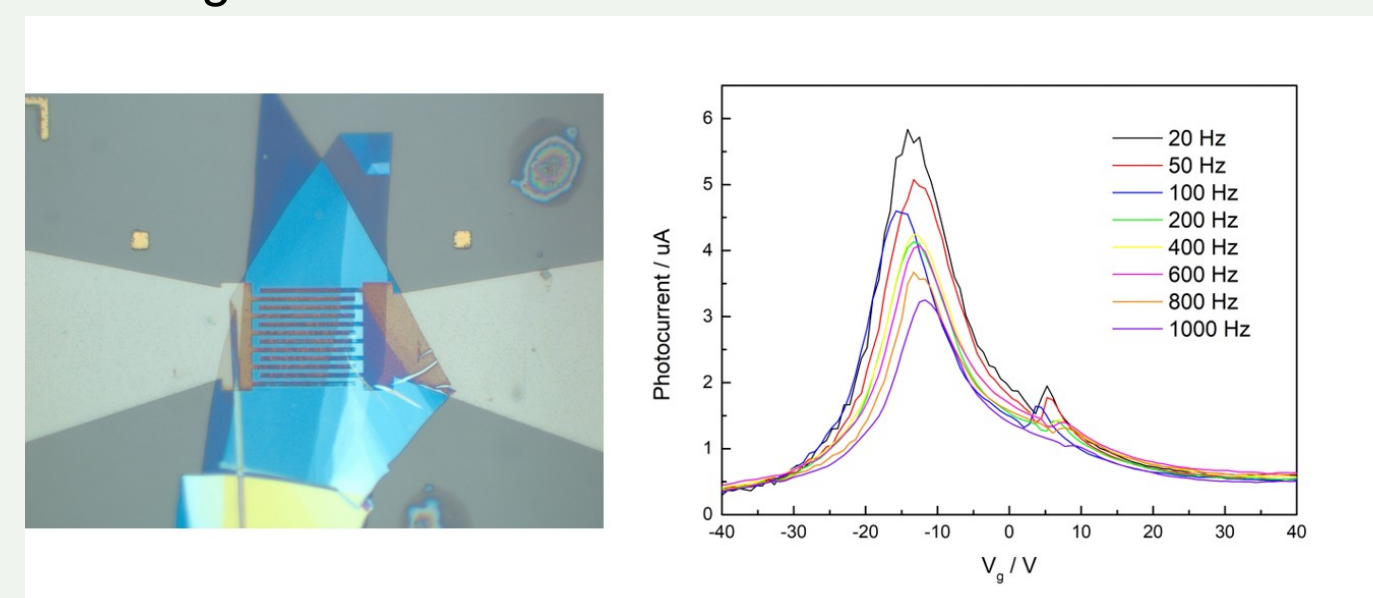
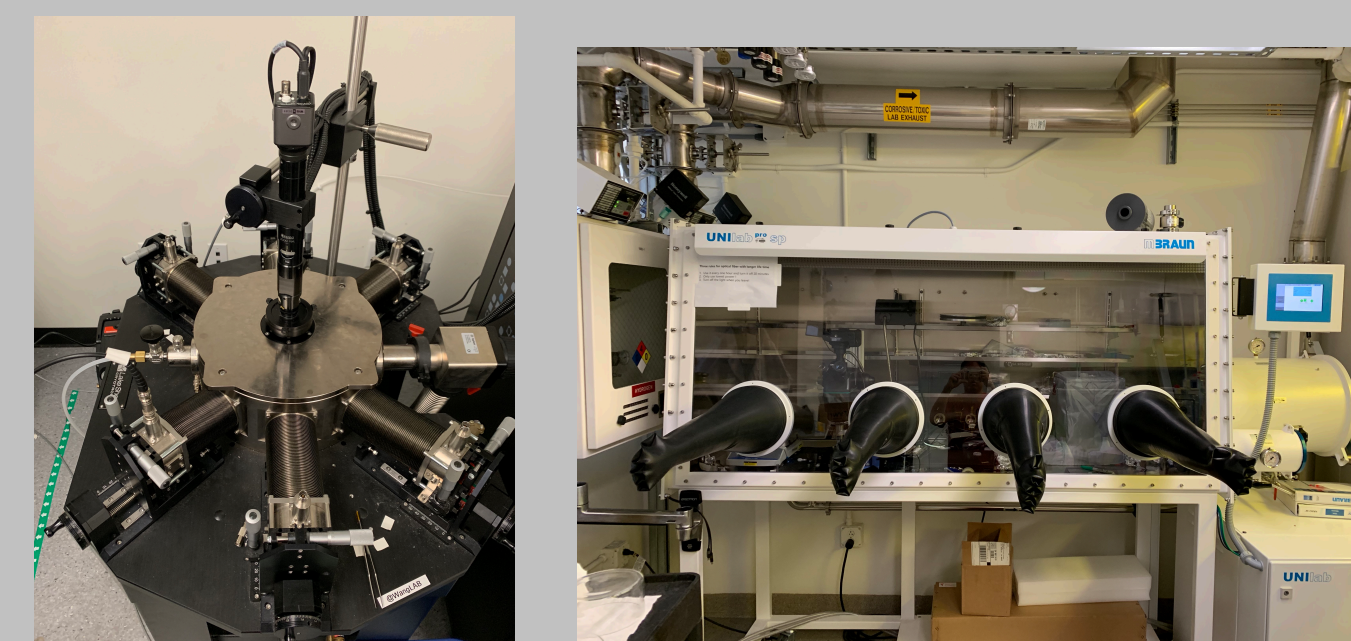


Figure 4. We also fabricated a device for photo-detection. We measured the photoresponse at IR with wavelength = 3.39  $\mu\text{m}$  and power = 20  $\mu\text{W}$ .

## How This Relates to Your STEM Coursework and Skills Learned

In the time I spent at Professor Wang's lab, I have learned to use devices such as the AFM, probe machine, and EBL. That has helped me to fabricate the devices that I use and to experiment with the devices to see their effects. At SHINE, I have also learned how the 2D materials that I work with are very useful in electrical engineering and the future of technology. In my time at SHINE, I also learned that electrical engineering is not just about numbers and that there is a lot of work that is hands-on with a high risk high reward factor.



## Next Steps for Me

SHINE was a great opportunity for me to experience electrical engineering and has helped me to further grow my interest in the STEM field and has helped me to find a new interest in two-dimensional materials that I may continue working on in the future.

## Acknowledgement

I would like to thank Professor Han Wang for giving me the opportunity to work in his lab as well as my mentor Nan Wang who has helped guide and support me throughout SHINE. Also, I would like to thank Dr. Mills and Dr. Herrold for hosting all our cohort meetings and for giving us this amazing opportunity.

## Fabrication Process for Devices

