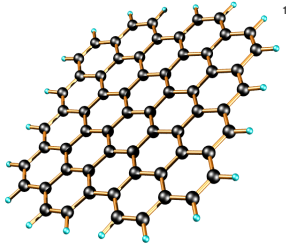


# Transport Properties and Surface Morphology Correlated Studies on Graphene Formed by Si Desorption of 6H-SiC

Will Roach  
Advisor: R. Ale Lukaszew

## What is Graphene?

- Single layer of carbon atoms arranged in a hexagonal lattice

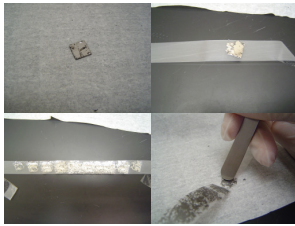


### Why graphene?

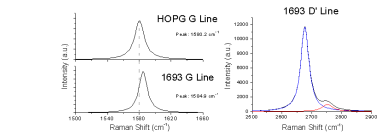
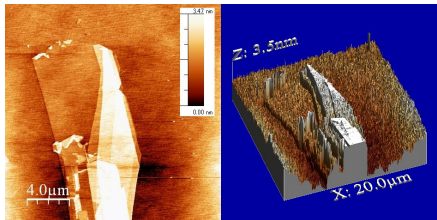
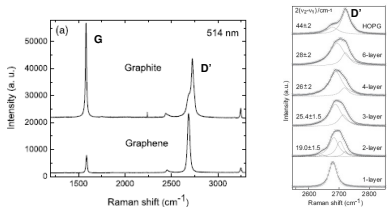
- High mobility<sup>2</sup>
- Thermoelectric<sup>3</sup>
- Spintronic devices<sup>4</sup>

## Exfoliated Graphene

- Obtained using "Scotch Tape Method"

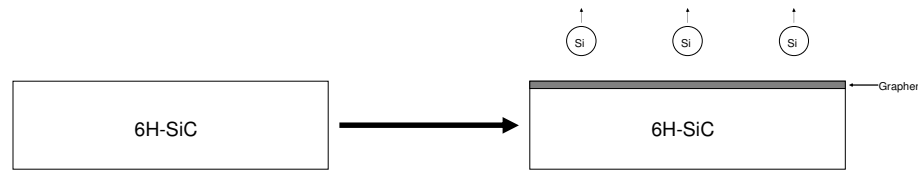


- Presence confirmed by Raman Spectroscopy<sup>5,6</sup>



## Epitaxial Graphene

- Obtained by high temperature annealing ( $\geq 1250^\circ\text{C}$ ) of 6H-SiC<sup>7</sup>



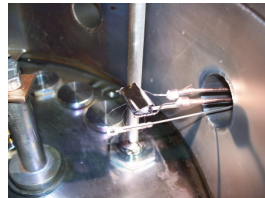
- Easily integrated into existing fabrication methods

## Issues in Epitaxial Graphene

- Lower mobility than exfoliated graphene<sup>8</sup> which is believed to be caused by surface roughness<sup>9</sup>
- Growth conditions (e.g. pressure, temperature, annealing time) greatly affect the quality of the films

## Fabrication and Characterization

### - Tantalum Oven



### - High Vacuum System

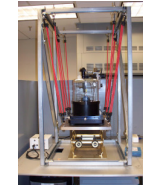
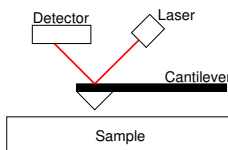


### - Raman Spectroscopy



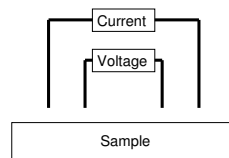
### - Atomic Force Microscopy

- Determines surface roughness



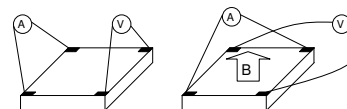
### - Four Point Probe

- Determines sheet resistance

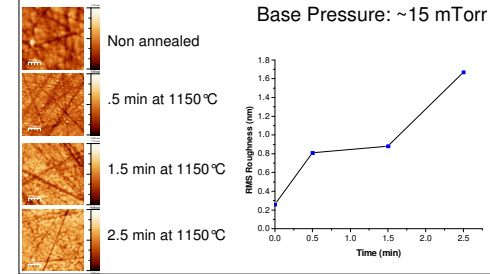


### - Van der Pauw-Hall

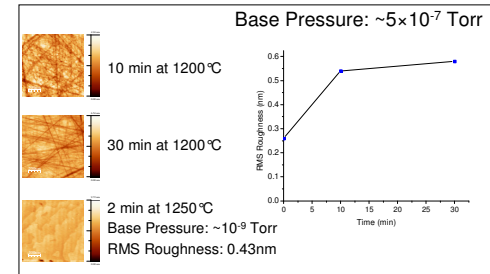
- Determines sheet resistance and mobility



## Low Vacuum



## High Vacuum



## Conclusion

There is clear indication that annealing with improved vacuum yields smoother surfaces. Further testing is necessary to determine an exact correlation between the roughness and the transport properties of epitaxial graphene films. Many parameters such as pressure, temperature, and annealing time factor into the quality of the films. After the effect of each parameter is determined, the goal will be to optimize the growth conditions in order to produce high quality samples. These growth conditions could then be integrated into existing fabrication methods to increase the performance of microelectronics devices.

## References

<sup>1</sup>[http://www.lbl.gov/Science-Articles/Archive/sabl/2007/Nov/assets/img/lrg/graphene\\_sheet.jpg](http://www.lbl.gov/Science-Articles/Archive/sabl/2007/Nov/assets/img/lrg/graphene_sheet.jpg)  
<sup>2</sup>K.S. Novoselov *et al.*, Science **306**, 666 (2004).  
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<sup>9</sup>K.V. Emtsev *et al.*, Nature Materials **8**, 203 (2009).

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