

Detecting and simulating graphene nanosheets on leaves of *Ceratophyllum Demersum*

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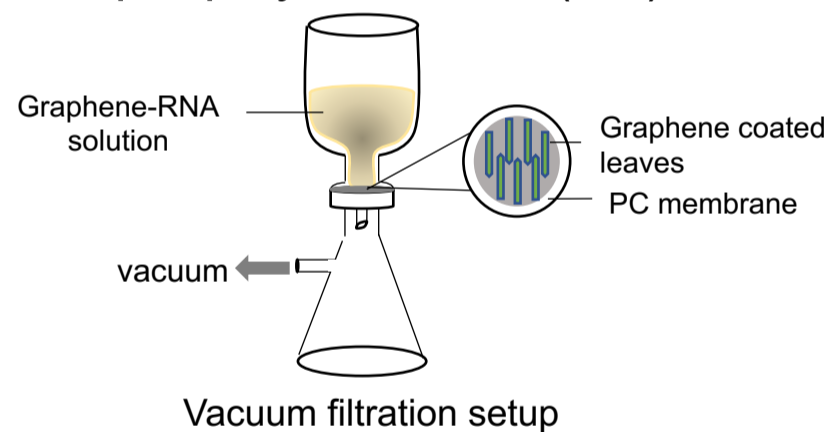
Introduction

- We have developed a method to image graphene flakes on leaves of aquatic plants using confocal microscopy

Method

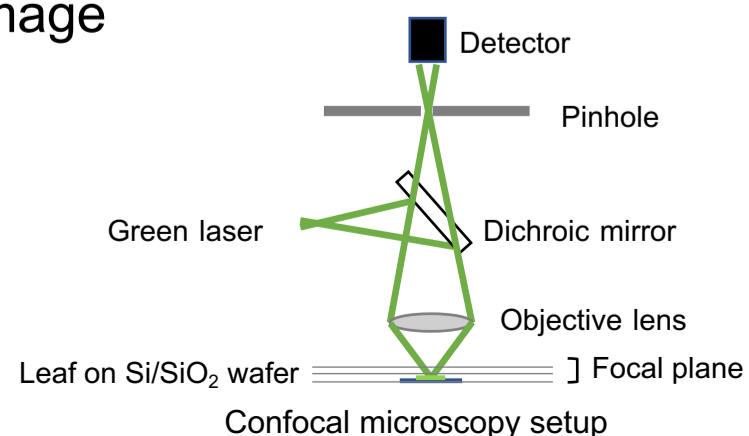
Sample Preparation

- 0.3g/L graphene-RNA6 solutions were prepared following standard procedure¹
- Solutions were vacuum filtrated onto freshly plucked *Ceratophyllum Demersum* leaves on a 0.2 μm polycarbonate (PC) membrane



Confocal Optical Microscopy

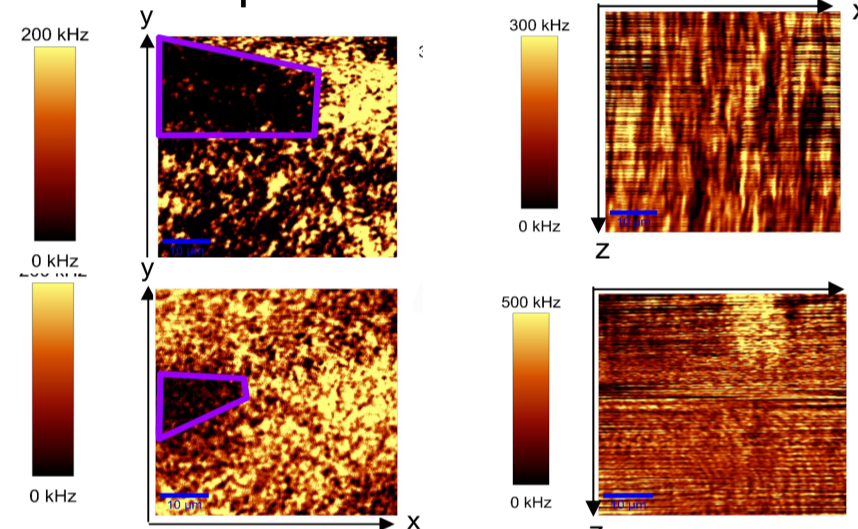
- Confocal microscopy was performed at 9 different heights on the leaves placed on a 300nm Si/SiO₂ wafer, using a green laser.
- The ability to change the height of the focal plane and capture and compare these images allows for the production of a 3D image



Results

Confocal Microscopy Images

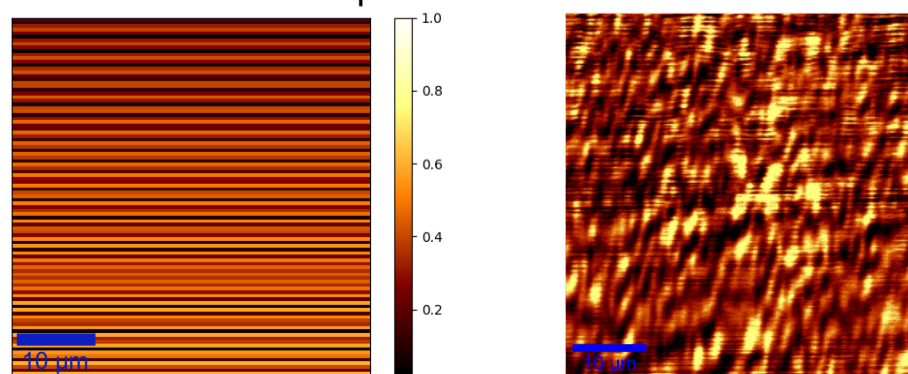
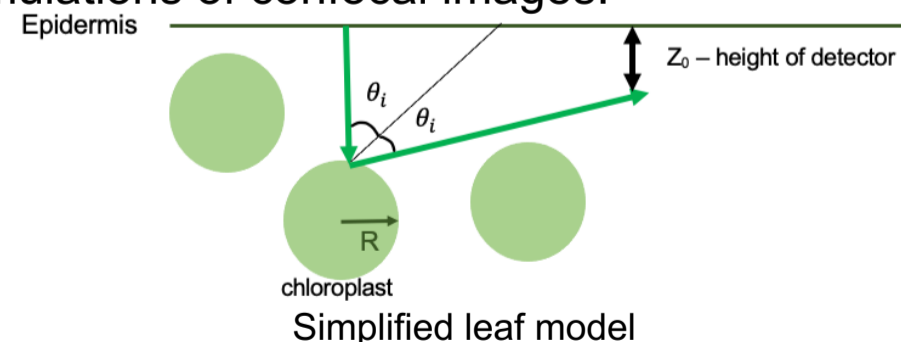
It was found that once vacuum filtrating 30 mL of the graphene-RNA6 solutions, large Graphene flakes on the surface of *Ceratophyllum Demersum* leaves could be found within 5 μm of the surface.



50 x 50 μm confocal images of graphene flakes taken at -5 μm , with corresponding depth image (50 μm deep). Graphene flakes are outlined in purple.

Leaf Simulations

Reflections at the chloroplast and epidermis, and light attenuation throughout the leaf were considered in our simplified leaf model to produce simulations of confocal images.



Simulation

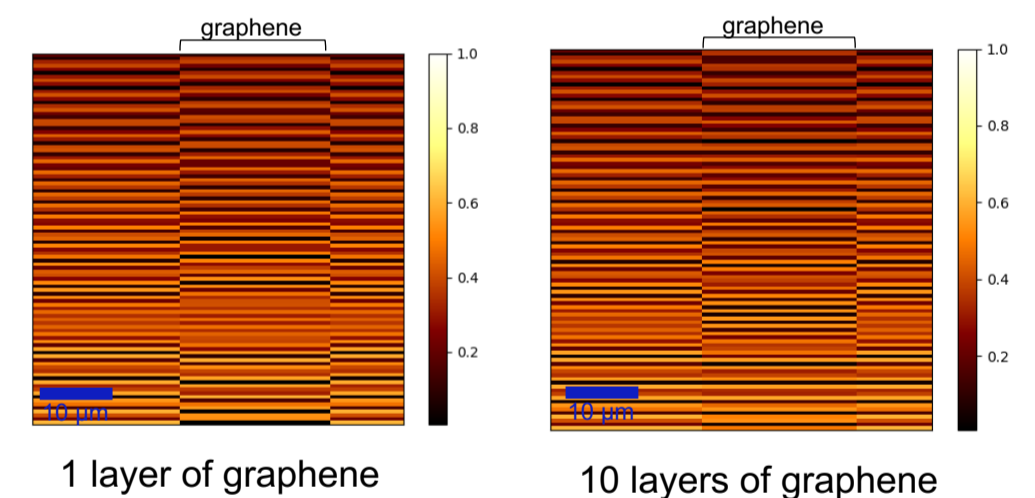
Confocal image

Conclusion

- Using confocal microscopy, graphene flakes residing on the upper epidermis³ of *Ceratophyllum Demersum* leaves were imaged, producing 3D images

Further Research

- Compare placement of areas of constructive and destructive interference in experimental images to simulations in order to determine the thickness of graphene flakes on the surface.



References

- ¹Sharifi, F. et al. (2012). Transparent and Conducting Graphene RNA Based Nanocomposites. *Small*. 8(5),699-706
- ²Blake, P. et al. (2007). Making graphene visible. *Applied Physics Letters*. 91(063124).
- ³Al-Abbawy, D. et al. (2020). Effects of salinity on biochemical and anatomical characteristics of *Ceratophyllum demersum* L. *Eurasia J BioSci*. 14, 5219-5225.

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