Probing interfaces between two-dimensional van der Waals materials with scanning probe microscopy

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1 Introduction

Atomically thin materials have been studied for decades despite a small amount of information known about them. These materials include graphene, hexagonal boron nitride (hBN), black phosphorous, and many more. Graphene has free moving electrons in the z axis, allowing for unconventional electronic properties that can revolutionize nanoelectronics, Many times, a material, such as gold, will be placed in-between the two van der Waal materials as an additional metal to further characterize these unconventional materials. When the two materials lay on top one another, the top layer can be rotated to cause Moiré lattices to occur. These lattices take place due to the mismatch of the materials' lattice structure. The Moiré lattices creates an alternate connection between the two van der Waal materials being observed. If the interaction between van der Waal materials can be better understood, it could revolutionize nanoeletronics. [1]

2 Procedure

AFM, or Atomic Force Microscope, is a type of scanning probe microscopy that allows one to image surface topography of the van der Waal materials. An additional probing method is EFM, Electrostatic Force Microscope, which allows for the probing of surface potentials and electrostatic forces of synthesized samples. These materials take place on the nano-scale, therefore human interaction tend to interfere with the data. In this experiment, I will attempt to counter this roadblock by using the scanning probe microscopy techniques mentioned above. Throughout the summer, I will build 2D layered materials and produce Moiré lattices from van der Waal materials. I will then use AFM and EFM to image the surface topography as well as characterize their surface potentials, capacitance, charge coupling, and relate the results to the twist angles of moire patterns.

References

[1] Kaustav Banerjee Pulickel Ajayan Phillip Kim. "Two-dimensional van der Waals materials". In: *Physics Today* 69 (Sept. 2016).