Thickness Calculation of HBN and Graphene Using RGB Colors

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The main objective of our research is primarily due to the required scientific exploration in the properties of a two-dimensional material called graphene. In order to achieve our goals, we want to induce a flat band graphene in order to maintain a nice platform that allows study of correlating physics. When graphene is combined with other materials in van der Waals heterostructures, we can electronically tune its band flatness. When achieved, electron kinetic energy decreases. This allows us to observe and study various correlation phenomena. Using Van der Waals heterostructures as a methodology for the measurement and alteration of graphene requires atomically homogeneous material to build it. The homogeneity of these materials plays an important role when using them to build our heterostructures.

We normally obtain them through mechanical exfoliation then search for them under a microscope. However, it is complicated to characterize the exact thickness of these materials optically. With this problem we looked for a solution by creating a program code. We seek to indicate through saturation comparisons between the different layers of hexagonal boron nitride (HBN) which serves as a dielectric material required for the composition of the heterostructure and Graphene. The code has been polished and altered to generate more efficiency towards the search for homogenous 2D materials. This project will significantly improve the efficiency for us to search for better flakes. Eventually leading to a higher device quality and potential observation of novel physics phenomena.

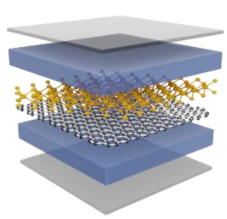

Fig. 1: Graphene (middle) in a Van der Waals Heterostructure.

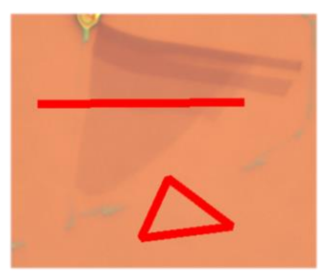

Fig. 2: Program Model examining homogenous structures.

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Supplementary Material

The created program uses the difference between contrast related to the thickness of our material as a measurement for thickness. We first shine white light that passes through our material. Then, due to the difference between values of index of refraction of HBN and graphite, our light interferes. Finally, the light wave obtains a different phase and gives us a specific color depending on the thickness of our material. Thus, we correctly specify the thickness of HBN and graphene with great precision. To make this program more efficient, it is necessary to implement a measurable line that is capable of changing size in order to obtain an average of pixels more specified with the limitations of our camera and thus be able to obtain graphs with less noise and more precise data. The solution was to add an algorithm called Bradenham's line algorithm that helps in obtaining an average value if we decide to change the thickness of our measuring line. Bradenham's Line Algorithm is an efficient way to draw a straight line on a pixel grid. It uses an error term to decide whether to move horizontally or diagonally, ensuring the line looks straight.

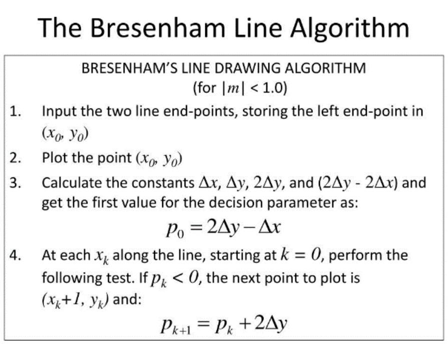

Fig. 3: Algorithm Process

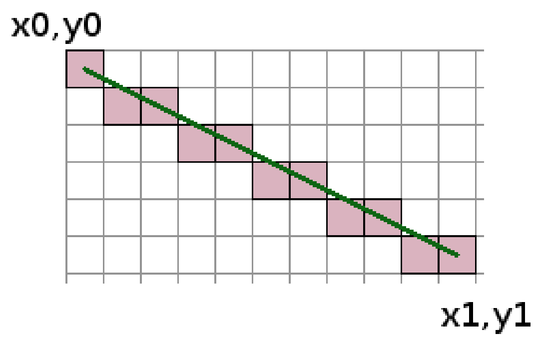

Fig. 4: Representation