Image Processing Algorithms towards Optical Detection of 2D Nanomaterials

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Traditional experimental techniques like AFM and STM used to characterize surface morphology of two dimensional nano structures are expensive and slow. Today it is possible to view such structures with the advent of white light contrast spectroscopy. However the process requires further optimisation in the wavelength of incident light and thickness of spacer material, rendering such experimental setups inefficient. The objective of my work was to design an image analysis software, capable of simulating the optimisation process using an algorithmic approach. Further, it was extended to obtain approximate thickness of each layer and refractive index. The first step was optimising the digital image of the nano structure captured with white light optical microscope. It's then converted into the HSV color model (Hue Saturation Value). While saturation channels distinguish between the layered nano-structures, the value channels shows the gaussian bulge due to uneven illumination and high frequency dirt present. The bulge is normalised by subtracting the two channels. Subsequently, we filter dirt by removing high frequency components. In the concurrent steps,we use K-means clustering to segregate the layers in the the optimized image. Since layers of different thickness exhibit different intensities, the position of each layer as well as average color is computed. Using our set of model equations we generated the reflectance as a function of wavelength i.e. average color.On varying quantities like thickness and refractive index,we minimised the distance between the measured and computed average color. Consequently the software used the predicted thickness to generate 3D morphology,from the 2D image using ordinary optical microscope for graphene,graphene oxide,BPT.

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