Measuring the Dielectric and Optical Response of Millimeter-Scale Amorphous and Hexagonal Boron Nitride Films Grown on Epitaxial Graphene

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Monolayer epitaxial graphene (EG) forms as a single crystal over millimeter-scale areas and consequently, the large scale single crystal can be utilized as a template for growth of other materials. We present the use of EG as a template to form millimeter-scale amorphous and hexagonal boron nitride (*a*-BN and *h*-BN) films. The *a*-BN is formed with pulsed laser deposition and the *h*-BN is grown with triethylboron (TEB) and NH_3 precursors, making it the first metal organic chemical vapor deposition process of this growth type performed on EG. Differential reflectance contrast (DRC) and Mueller matrix ellipsometry (MME) are primarily used to determine the optical absorption and dielectric functions of the EG, *a*-BN, and *h*-BN within the energy range of 1 eV to 8.5 eV. Furthermore, we report the first ellipsometric observation of high-energy resonant excitons in EG from the 4H polymorph of SiC and an analysis on the interactions within the EG and *h*-BN heterostructure. The growth of 2D materials on EG presents a favorable mechanism to enable heterostructures of 2D materials to exploit the exciting properties and multifunctionalities that can arise from multi-material van der Waals structures. [1]

References

[1] A. K. Geim and I. V. Grigorieva, Nature, 499 (2013), 419.

Figures

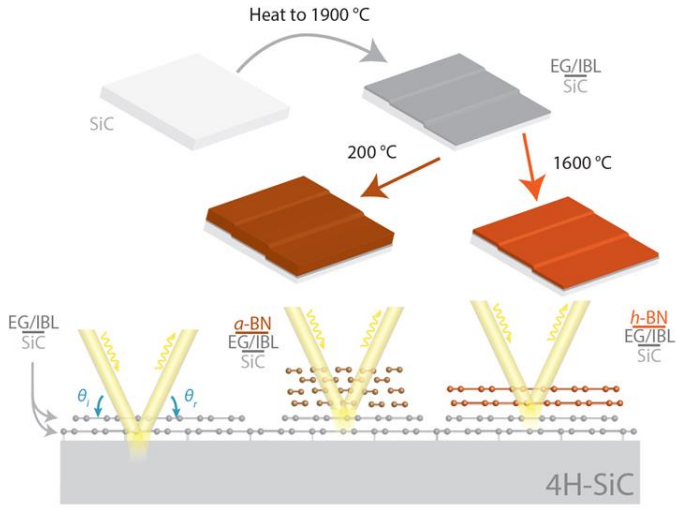

Figure 1: Illustration of depositions on epitaxial graphene and subsequent ellipsometric measurements.

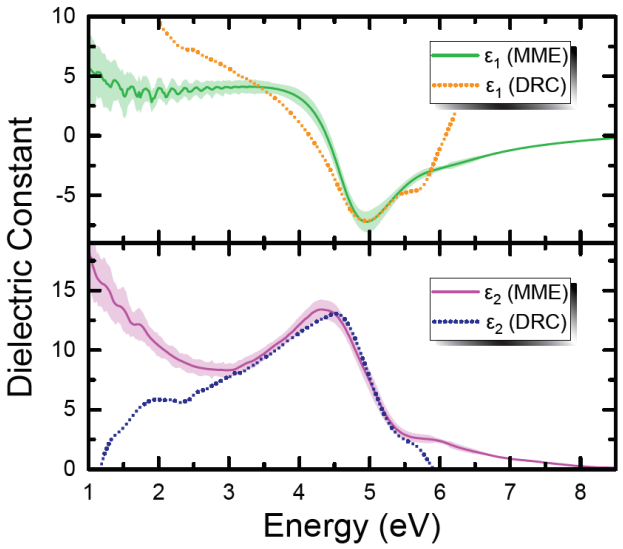

Figure 2: The MME-based dielectric function of EG is extracted in its most accurate form after accounting for the buffer layer and 4H-SiC beneath. The real and imaginary portions are shown in green and purple, respectively. The DRC-based dielectric function is calculated with Kramers-Kronig relations, and its real and imaginary portions are shown in dotted orange and dotted blue, respectively. The shading for all curves indicates a 1 σ uncertainty.