Optimization of Temperature Conditions for Pristine Graphene Synthesis

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Typical graphene is grown through chemical vapor deposition (CVD) which requires high temperatures (1,100-1,600 °C) and complicated transfer processes that frequently result in the loss and contamination of sample material. Therefore, the purpose of this experimentation was to develop and optimize an alternative graphene synthesis process. It was hypothesized that an external plasma source could be used to significantly reduce the temperatures required to synthesize transfer free pristine graphene. During the experimentation, the substrates (Cu and Ni foils, Si wafers, and glass) were first prepared and the graphene was then synthesized via the use of a split ring, capacitively coupled, RF (radio frequency) plasma system. The plasma field generated by the RF system broke apart the polar covalent bonds of the methane gas introduced into the system, causing the Carbons to precipitate on the substrate surface. The data collected from SEM (scanning electron microscopy) imaging of the produced graphene demonstrated vertical growth that occurred due to the perpendicular orientation of the substrate relative to the electric field generated by the plasma. Raman spectroscopy demonstrated that the optimum temperature to produce pristine graphene (2D/G band ratio was 1.5) was at 650 °C. This experimentation solved the two tremendously problematic issues in current graphene synthesis. The qualities measured by PECVD grown graphene could be adjusted by altering growth parameters. Low quality graphene can be synthesized at 25% of conventional temperatures with qualities desirable for energy storage. PECVD graphene not only had intriguing semi-conductive properties but also has tremendous applications in medical, consumer, industrial, and military fields.

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