



Laser Precision-Based Graphene Growth Processes

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Abstract

This paper discusses laser methods for fabricating large-area, high-quality graphene. Common methods for epitaxial graphene growth including thermal decomposition of SiC apply energy evenly across an entire substrate, leading to simultaneous nucleation of graphene crystals in many locations and thus poor continuity over large areas. A proposed alternative method is to use a defocused laser to apply energy at a single nucleation site, and then propagate graphene growth by scanning the laser along the substrate. This concept has been tested in two versions. First, in a variation of the established method of SiC thermal decomposition, the laser can heat a point on a SiC substrate, driving off Si to nucleate graphene. This is followed by scanning of the laser to extend the graphene growth out from the nucleation point. In the second method, a highly controlled version of Pulsed Laser Deposition (PLD) known as Through Thin Film Ablation (TTFA), can be used to deposit a precise volume of carbon nanoparticles onto a substrate material with a hexagonal-close-packed lattice. The substrate structure then acts as a template for rearrangement of the surface carbon into graphene as the heating laser is swept across the surface. Finally, the same defocused laser rastering technique has also been applied to anneal previously existing epitaxial graphene with the intent to improve its crystallinity. Raman spectroscopy characterizes the graphene grown or annealed by these methods.

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