[Invited] Rethinking High-Performance CVD Graphene Nanoelectronics on Oxidized Silicon

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The fast carrier transport in graphene has attracted substantial research and commercial interest particularly for nanoelectronic applications such as analog and radio-frequency (RF) circuits [1-3]. In these circuits, the electronic performance such as gain and bandwidth are often commensurate with the transistor carrier transport properties such as charge mobility and velocity saturation. In the past few years, graphene on hexagonal boron nitride (h-BN) interfaces has attracted significant attention as an ideal combination owing to the smooth interface, and reduced electron-hole puddles and surface impurities [4, 5]. However, the scalable high-quality growth of h-BN remains challenging let alone the synthesis of high-quality graphene/h-BN stacks. For this reason, it is appropriate to revisit graphene on standard electronic substrates.

In this talk, I will highlight the substantial recent progress on graphene synthesis on standard substrates and the high-performance electronic properties arising from the synthesized monolayer. Nearly defect-free monolayer graphene can now be synthesized by CVD at wafer-scales with material quality comparable to ex-foliated natural flakes with the only limitation coming from the grain size [6, 7]. The monolayer can be transferred with minimum polymer residue as determined by Raman spectroscopy and optical microscopy.

Fabricated transistor devices from CVD graphene on oxidized silicon now readily afford mobilities over 10,000 cm^2/V-s with on/off current ratio that exceed an order of magnitude while maintaining the intrinsic electron-hole symmetry. Notably, the device performances are achieved at room-temperature under ambient conditions, which is essential for electronic circuits. Analog circuits including amplifiers and frequency multipliers from CVD graphene both offer positive gains, an important milestone for graphene electronic circuits. I will conclude by elucidating the prospects of graphene electronics on standard oxidized silicon substrates.

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