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Epitaxial graphene electronics and optoelectronics

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Graphene demonstrates exceptional properties such as high charge carrier mobility and high saturation velocity. Such attributes make graphene a promising candidate for radio frequency (rf) applications. However, one of the key limitations to the realization of graphene's full potential comes from its interaction with dielectric over layers and metal contacts, which act to limit the excellent charge transport properties of graphene. We have directly demonstrated the importance of buffer elimination at the graphene/SiC (0001) interface where enhanced carrier mobilities of >3000 cm^2/Vs across large scale wafers is possible. Additionally, we have developed a robust method for forming high quality ohmic contacts to graphene, which improves the contact resistance by >1000X compared to untreated metal/graphene interfaces. We have also developed methods for ultra-thin gate oxides, and will discuss integration and the importance on improved interfaces between the graphene and dielectric. Each of these developments have provided a means to achieve graphene transistors with current saturation values >1.5 A/mm, transconductance > 400mS, record *extrinsic* current gain response of epitaxial graphene transistors (>30 GHz), and *intrinsic* current gain nearing 150 GHz. In addition to graphene electronics, the importance of graphene optoelectonics is ever increasing, with recent reports of ultrafast transistor-based photodetectors made from single- and few-layer graphene demonstrating optical intensity modulations up to 40 GHz, with an intrinsic bandwidth > 500 GHz. Our work focuses on developing a fundamental understanding of photoresponse of epitaxial graphene, and we demonstrate photon energy selectivity based on the band structure of graphene/SiC, with high sensitivity and rapid response.

Biography

Robinson has published dozens of high impact journal articles on carbon nanotubes and epitaxial graphene, and has given twelve national and international invited talks on graphene and related materials at high profile conferences and symposiums. Most recently, Dr. Robinson's work in graphene materials and devices resulted in the "Rustum and Della Roy Innovation in Materials Research Award" for innovative and interdisciplinary research. Finally, and quote notably, Dr. Robinson is more experimentally sound in the art of tipple ingestion than his friend and colleague Dr. Joshua Caldwell of the Naval Research Laboratory.

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