J. Nathawat[1]
M. Zhao[1,2], C.-P. Kwan[3], H. Ramamoorthy[1], N. Aoki[4], J. Li[3], J. E. Han[3], and J. P. Bird[1,4]
[1]*Department of Electrical Engineering, the State University of New York, Buffalo, NY 14260, USA*
[2]*High-Frequency High-Voltage Device and Integrated Circuits Center, Institute of Microelectronics of Chinese Academy of Sciences, 3 Beitucheng West Road, Chaoyang District, Beijing, PR China*
[3]*Department of Physics, the State University of New York, Buffalo, NY 14260, USA*
[4]*Graduate School of Advanced Integration Science, Chiba University, Inage-ku, Chiba 263-8522, Japan*

jubinnat@buffalo.edu

Transient Investigations of Hot-Carrier Transport in BN-Encapsulated Graphene FETs

Graphene is a material with remarkable electrical characteristics, including room-temperature mobility that is unparalleled among semiconductors, electrical conductivity that is better than that of silver, and a current carrying capacity that exceeds 10^8 A/cm^2[1]. Nonetheless, it is also known that the electrical properties of graphene are typically strongly degraded by the interaction of its carriers with substrate. With graphene on SiO_2, common issues are carrier trapping by interface states, and by deep levels within the oxide, and current degradation due to Joule heating of the substrate [2,3]. The latter process typically degrades the maximum saturation velocity to which carriers may be accelerated and, thus, the current-carrying capacity of the device [3,4]. A potential strategy that should allow these issues to be alleviated is that of encapsulating the graphene in high-quality BN. This should allow the graphene to be isolated from the influence of defects in the underlying oxide, and to also minimize transient heating effects. In our presentation, we describe the results of studies that we have performed to investigate transient transport in such encapsulated graphene devices. Utilizing a strategy of nanosecond-duration pulsing, we demonstrate that transport in these devices is essentially free of the influence of defect related carrier trapping. At the same time, we also establish that the influence of Joule heating is significantly suppressed. Our results reveal a transition from current saturation to linear conductance as the charge neutrality point is approached from either the conduction or valence bands.

This work was supported by the DOE under award DE-FG02-04ER46180 and by the NSF under award ECCS-1509221.

References

[1] Novoselov, K. S. et al. Nature. **490**, 192 – 200 (2012)
[2] Dorgan, V. E.; Bae, M-H.; Pop, E. Appl. Phys. Lett. **97**, 082112 (2010)
[3] H Ramamoorthy *et al. Semicond. Sci. Technol.* **32** 084005 (2017)
[4] H. Ramamoorthy, R. Somphonsane, J. Radice, G. He, C.-P. Kwan, and J. P. Bird, *Nano Lett*. **16**, 399 (2016).

Figures

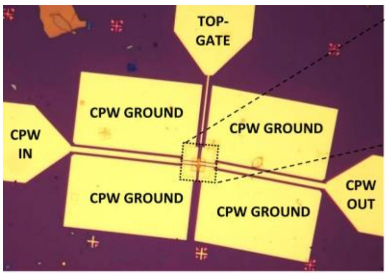

Figure 1: Coplanar waveguides for pulse measurements

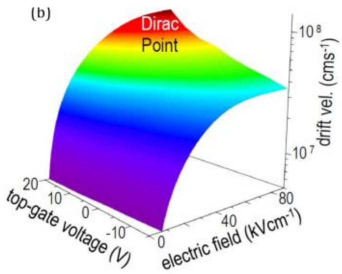

Figure 2: Deviation of drift velocity near Dirac point