Recent Advances in Graphene-Based Radio Frequency (RF) Nanoelectronics

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Graphene as a material has created a lot of interested due to properties like high saturation velocity, high current carrying capacity, ambipolar characteristics and high transconductance. These properties make graphene based transistor an exceptional candidate for high frequency applications. Traditional DC measurements are not sufficient when considering graphene transistor for high frequency RF circuit design. Recently, our research group has demonstrated RF current voltage (I-V) measurement on graphene transistor with HfO_2 high-κ dielectric. The extracted RF I-V shows 50% increase in current as compared to their DC I-V characteristics [1]. The increase in current and transconductance is attributed to reduced contribution of high-κ bulk traps at GHz frequency with promising implications for low noise amplifier (LNA) applications. The symmetric ambipolar transport in graphene FETs makes them promising for single FET mixer applications. We have recently fabricated hydrogen intercalated epitaxial graphene transistors on large area Silicon Carbide substrate, with highly scaled equivalent oxide thickness, EOT, to demonstrate record high conversion gain for a single graphene transistor ambipolar mixer, achieving a small circuit footprint. Ambipolar gate mixing was shown to suppress odd order harmonics and was found to outperform resistive drain mixing [2].

References:

[1] H. Madan, M. J. Hollander, J. A. Robinson, and S. Datta, "Extraction of Near Interface Trap Density in Top Gated Graphene Transistor Using High Frequency Current Voltage Characteristics" Device Research Conference (DRC), Penn State University, June 18-20, 2012

[2] H. Madan, M. J. Hollander, M. LaBella, R. Cavalero, J. Robinson, and S. Datta, “Record High Conversion Gain Ambipolar Graphene Mixer at 4-10GHz Using Scaled Gate Oxide”, International Electron Device Meeting (IEDM), San Francisco, Dec 10-12, 2012