

Graphene Transistor Employing Multilayer Hexagonal Boron Nitride as Substrate and Gate Insulator

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Abstract : We explore the potential of using ultra-thin hexagonal boron nitride (h-BN) as both supporting substrate and gate dielectric for graphene-channel field effect transistors (GFETs). Different from commonly used oxide-based dielectric materials which are typically amorphous, very rough in surface, and rich with surface traps, h-BN is layered insulator free of dangling bonds and surface states, featuring atomically smooth surface. In a graphene-channel-last device structure with local buried metal gate electrode (TiN), thin h-BN multilayer is employed as both supporting “substrate” and gate dielectric for graphene active channel. We observed superior carrier mobility and electrical conduction, significantly improved from that in GFETs with SiO₂ as substrate/gate insulator. In addition, we report excellent dielectric behavior of layered h-BN, including ultra-low leakage current and high critical electric field for breakdown.

Keywords : graphene, field-effect transistors, hexagonal boron nitride, dielectric strength, tunneling

Conference Title : ICNST 2015 : International Conference on Nano Science and Technology

Conference Location : Kuala Lumpur, Malaysia

Conference Dates : February 12-13, 2015