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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
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