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Graphene Heterostructure Field Effect Transistors Encapsulated by Isotopically Pure Hexagonal Boron Nitride

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Abstract:

Graphene, an atomically layered 2D semimetal has been a prime focus of study in the last two decades for its use as a channel material in field effect transistors (FETs) due to its high carrier mobility originating from graphene's linear band dispersion. Recent studies have also shown that enhanced electrical mobility, low contact resistance and ballistic transport can be achieved in graphene by fabricating one-dimensional edge contacts in a graphene channel encapsulated by hexagonal boron nitride (hBN). Furthermore, low frequency noise (LFN) studies on such hBN encapsulated graphene heterostructure field effect transistors (HFETs) have shown ultra-low noise in carrier rich regions. However, most of the studies on graphene-based HFETs incorporate hexagonal boron-nitride with naturally occurring boron isotopic concentration. Boron, a constituent element in hBN, has two isotopes, ^{10}B and ^{11}B. Naturally occurring hBN has a boron constituent ratio of 20% ^{10}B and 80% ^{11}B. In this presentation we will discuss a comparative study that we performed on both the temperature dependent transport and LFN of single layer graphene (SLG) HFETs encapsulated in natural and isotopically pure hBN. Understanding the carrier physics of SLG in different isotopically pure encapsulated geometries will aid us in engineering low-noise graphene-based FETs for future digital electronics.

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