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Graphene Quantum Point Contact Transistor for DNA Sensing[1]

ANUJ GIRDHAR, Beckman Inst — Over the past few years the need has grown for low-cost, high-speed, and accurate biomolecule sensing technology. Graphene is a promising choice for use in such sensing applications, as its single-atom thickness and unique electronic structure is suitable for probing biomolecules like DNA at a very high resolution. We propose the design of a transistor containing a graphene nanoribbon sensing layer with a nanopore for the simultaneous detection and control of a translocating DNA molecule. Through the combination of molecular dynamics simulations, a self-consistent Poisson equation solver, and electronic transport theory, we show that the motion of a DNA molecule through a nanopore can be observed by measuring conductance modulations in the graphene nanoribbon. We also demonstrate that the sensitivity of the graphene sheet conductance to external charges can be enhanced by modulating its carrier concentration as well as by choosing a quantum point contact geometry for the graphene nanoribbon. In addition, we propose the use of extra gates to control both the lateral and translocating motion of a DNA molecule inside the nanopore.

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