Fabrication of a Multilayer Graphene Based Single Electron Transistor with Chemically Transferred Graphene

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A Single Electron Transistor (SET) is a device which conducts electrical current through a specified pathway and into a particle of choice in order to study the quantum properties of that particle. Initial fabrication of this device yields a SET with two main components: contacts which funnel the current and nanowires which hold the particle. The nanowires resemble an hourglass shape, and only after the constricted middle section is broken can a particle be placed in the device. The engineering goals of this project are to (1) Chemically render one sheet of graphene and (2) out of this graphene fabricate an SET with a 1.5-2 nanometer gap. The first is accomplished by first spin coating the copper coated sample with PMMA 4, etching the graphene with O2 plasma oxidation, then developing the sample in fresh ultrapure water. The second is accomplished by developing the graphene mask using UV light, writing the gold contacts, then imaging with an AFM to ensure a closed system. The purpose of fabricating an SET with broken nanowires is to study the quantum behavior of particles, which is crucial to the advancement of quantum computing. Presently, there is a cap at which information can be transmitted, as it can only be transcribed through binary code (0's and 1's). With quantum computing, bits and bytes of information can be transcribed through states other than zero and one, which translates to theoretically infinite speeds. Being able to characterize such small particles will reduce the size of processors while exponentially increasing speeds. This experiment produced a graphene based Single Electron Transistor chemically transferred graphene, and a 1.7 nanometer gap and 40 nanowires.