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Fabrication and investigation of electric properties of monolayer fluorinated graphene and its junction with conductive monolayer graphene

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Abstract

Graphene, the mother of 2D materials, has become a unique material for use in a wide range of applications due to its extraordinary properties such as electric conductivity, thermal conductivity, high charge carrier density, high charge mobility, and good optical and chemical properties. In this research, Cr electric contacts were produced by photolithography on the desired substrate, and monolayer graphene was transferred on top. Samples were functionalized at 15s and 30s in 20-50 W SF6 plasma. Optical, electron, and atomic force microscopic techniques along with Raman spectroscopy and energy dispersive X-ray analysis were used to examine the quality, continuity, elemental and structural properties of the samples. Current voltage before and after graphene functionalization demonstrated that at a specific plasma time, plasma power between 20-50 W is not a critical parameter rather, plasma time is the critical parameter in current modification. 15s SF6 plasma reduces the current passing through monolayer graphene due to its high electron affinity and further increases the plasma time to 30s, diminishes monolayer graphene conductivity, and turns into an insulating 2D material with atomic thickness. Raman spectroscopy of fluorinated monolayer graphene demonstrated that an increase in time and plasma power, decays crystal structure and increases impurities and defects in the lattice. These were qualitatively extracted from the Raman spectra and discussed. Finally, fluorine was sandwiched between two conductive and nonconductive layers and restored electrical current. Applying back-gate voltage had an insignificant impact on the current modification of graphene.

Keywords: graphene, electrical characterization, photolithography, fluorination, Raman

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