Nitrogen-doped graphene: synthesis and properties

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Graphene is considered as one of the moSt perspective materials for different nanoelectronic devices. Due to aspiration for controlling its electronic properties, a variety of possible functionalized forms of graphene attracts particular attention [1, 2]. The moSt obvious route in this direction is graphene doping by different types of atoms. Simulations show than graphene doping opens a possibility to construct tunable electronic devices through control of the dispersions and electron-phonon coupling [3]. One of the possibilities for graphene doping is incorporation of nitrogen atoms into the graphene lattice [2, 4].

This work is dedicated to exploration of the possibility of CVD-grown graphene electronic structure tuning by nitrogen doping. A combined study by means of core-level (XPS) and angle-resolved (ARPES) photoelectron spectroscopy as well as scanning tunneling microscopy (STM) is presented.

In order to study the process of N-doped graphene synthesis, a real-time photoemission study was carried out during chemical vapor deposition (CVD) procedure. It provided comprehensive information on the mechanism of N-graphene growth. It is shown that N-doped graphene with nitrogen concentration of 0.5-2% can be synthesized by means of CVD on a nickel surface. Spatial distribution of N atoms in graphene film is discussed in view of XPS and STM results.

In order to explore the bandstructure at the Fermi level, graphene was transformed into a quasi-freestanding state using gold intercalation technique. It is shown that N atoms, incorporated into graphene lattice, act as electron donors, transforming graphene into n-type semiconductor. This results in a shift of a Dirac cone towards higher binding energies, observed with ARPES.

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[4] J.C. Meyer et al., *Nature Mat.* **10**, 209 (2011).