Towards synthesis and characterization of heterogeneously doped graphene nanostructures

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ABSTRACT

Graphene and its nano-functionalization are hot research topic. Besides the promising mechanical and electronic properties of pristine graphene [1], various possibilities for the functionalization of graphene through e.g., structural defects, [2] such as vacancies and single atom impurities or chemical adsorption [3], are reported to enhance its the chemical activity and tune its electronic properties. Functionalized graphene is predicted to have potential applications as gas sensors [4] or nanoelectronics [5], serving as energy efficient conversion material or stable nanostructured semiconductors. Although various theoretical studies predict high potential of such materials [6], their synthesis remains challenging and effective extension to large-scale synthesis is missing. The direct incorporation of heteroatoms into the graphene mesh was extensively reported for B and N but, to our knowledge, only Ni [9], Pt and Au [7] metals were reported to replace a carbon atom in the honeycomb structure of graphene. Nevertheless, theoretical calculations predict that several transition metal single atoms can be used to tune the graphene properties, for example Co can be added to enhance its activity towards HER [8]. In this work we investigated a new route to produce by means of a potentially scalable method a single graphene layer where a sizable amount (few %) of single Co atoms are trapped in the mesh. The Co-doped layer is characterized by means of variable temperature scanning tunneling microscopy (STM), x-ray photoelectron spectroscopy (XPS) and low energy electron diffraction (LEED).

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