The CVD formation of multi-graphene clusters in CNT growth system CVDomna

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Practical realization of nanostructures based on graphene in electronics and optoelectronics has raised the question of obtaining high-quality graphene samples of large area. One of the promising method of monolayers graphite formation (graphene) and other electrically conductive layered materials is the chemical vapor deposition (CVD) that allows to produce large area graphene monolayers [1].

We suggeSt the methodic of graphene growth based on the ethanol pyrolysis from the gas phase.

The investigation of growth methods were carried out on carbon nanotubes growth system CVDomna, which allows to grow carbon nanotubes by ethanol. Unlike the devices of a similar type, CVDomna can synthesize a variety of carbon nanomaterials on different surfaces with a dimensions up to 3 inches. Usage the gas mixture of ethanol requires the control of the reaction, because simultaneously with the process of growth occurs the material oxidation.

The dissolution process of reactivity from carbon monoxide in a metal catalySt (in this work Ni film of 200 nm thickness) occurs before the complete dissolution of the liberated carbon in the bulk of the catalyst

Thus, the saturation of carbon-film catalySt and the formation of solid solution of metal-carbon bonds. When the critical carbon content is reached the reaction chamber cooling leads to faster release of carbon, as well as to stop the growth of graphene monolayers. Consequently, the higher the temperature of the reaction, the more carbon will react withthe catalyst, and the sooner we will cool the reaction chamber, the less carbon is formed on the film surface of the catalyst

The thickness of multi-graphene clusters been grown using this technology, was investigated by scanning probe microscopy. Studies have shown that a thin film multi-graphene formed by the reaction on the catalyst surface. Cooling rate, which determines the surface morphology is also affect quality of the material. In one case, we obtain a homogeneous film, otherwise there is a formation of graphene islands.

These results show that need further study the mechanism of action at the substrate-catalystand its influence on the growth of carbon nanomaterials.

[1] Yasumitsu M., Keiichi K., Kazunori O., Ryo K., Masamichi Y., Hisanori S., *Applied Physics Letters* 96 (2010).