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Synthesis of Two Dimensional Carbon Nanosheets through C-H Activation Reaction in Solution Plasma

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Carbon nanomaterials, especially two dimensional graphene or graphene-like carbon nanosheets have received much attention in the variety of fields owing to their outstanding electrical, mechanical, thermal and chemical properties. Therefore, synthesis methods such as mechanical exfoliation, chemical vapor deposition and total organic synthesis have been widely studied recently [1]. Quiet recently, liquid phase plasma method named solution plasma process (SPP), has been applied to fabricate a various type of carbon nanomaterials. Top-down approaches of SPP for preparation of carbon nanomaterials have successfully produced graphene flakes or carbon onions from graphite electrodes by controlling of plasma discharge conditions [2]. In addition, bottom-up approaches also have successfully synthesized various types of carbon nanomaterials (*e.g.,* carbon nanoball (CNB), heteroatom-doped carbon *etc.*) through C-H activation reaction in organic solvents [3]. Generally, C-H bonds have relatively high energy, therefore, the synthesis of carbon-carbon or carbon-heteroatom bond by dissecting C-H bond has been considered to be difficult and required rather harsh reaction conditions (*e.g.,* high temperature, metal catalyst, strong acidic or basic condition *etc.*). In this respect, SPP has potential to produc advanced carbon nanomaterials because it can provide energy for the C-H activation reaction under atmospheric temperature and pressure.

In this work, we tried to synthesize two dimensional carbon nanosheets through bottom-up approach of SPP by controlling the solvent and solute. The plasma discharge in organic solvent was generated by using bipolar pulse power supply and operated at 25 kHz of pulse frequency, 1.0 μs of pulse width, and 1.0 mm electrode gap distance, respectively. Morphology, crystal structure and chemical components of as-prepared carbon materials were observed by transmission electron microscopy (TEM), selected area electron diffraction (SAED) pattern, Energy-dispersive X-ray spectroscopy (EDS) and elemental mapping.

Reference

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