Rapid Synthesis of Ultrathin Graphdiyne Film at a Microwave Induced-Temperature Gradient Solid/Liquid Interface

Presenting Author
Chen Yin, Jin Zhang*

Center for Nanochemistry (CNC), College of Chemistry and Molecular Engineering, Peking University, Beijing 100871, China

yinchen-cnc@pku.edu.cn

Abstract

As a new type of carbon allotrope, graphdiyne (GDY) is merely composed of sp and sp2 hybridized carbon atoms with high degrees of π-conjugation, which is predicted to possesses high carrier mobility and have natural bandgap simultaneously. However, the synthesis of one or few-layer GDY with good crystallinity remains challenging due to the high sensitivity of the monomer – hexaethynylbenzene (HEB). Here we report a rapid synthetic method of ultrathin GDY film at a microwave induced-temperature gradient solid/liquid interface. A solid/liquid interfacial protocol involves sodium chloride (NaCl) as the solid substrate, which can absorb microwave and heat HEB to control the cross-coupling reaction and a non-absorbing microwave solution of HEB makes HEB remain stable. A multilayer GDY films with an average thickness of less than 2 nm emerges through a cross-coupling reaction at the interface. Raman spectra, X-ray photoelectron spectroscopy, and transmission electron microscopy characterization all confirmed the features of GDY. The structural characterization and spectroscopic characterization of the prepared GDY film were carried out. The field-effect transistor device based on GDY film proved to have good conductivity and exhibited p-type characteristics under the action of gate voltage modulation. The field-effect mobility of GDY films is calculated as 50.1 $cm^2 V^{-1} s^{-1}$.

References

1. Novoselov, K. S.; Geim, A. K. et al. Science 2004, 306, 666.
2. Lin, G.; Li, Y. et al. Chem. Commun. 2010, 46, 3256-3258.
3. Shi, L., Chen, K., Du, R., Bachmatiuk, A., Rümmeli, M. H., & Priydarshi, M. K., et al. Direct synthesis of few-layer graphene on nacl crystals. Small. 2016, 11(47), 6302-6308

Figures

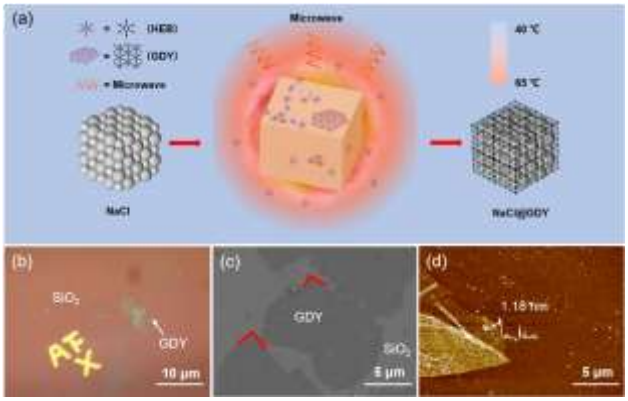

Figure 1:(a) Schematic presentation of the synthesis process of GDY films. (b, c) Optical and SEM images of GDY films on SiO2/Si substrate. (d) Typical AFM image of GDY films.

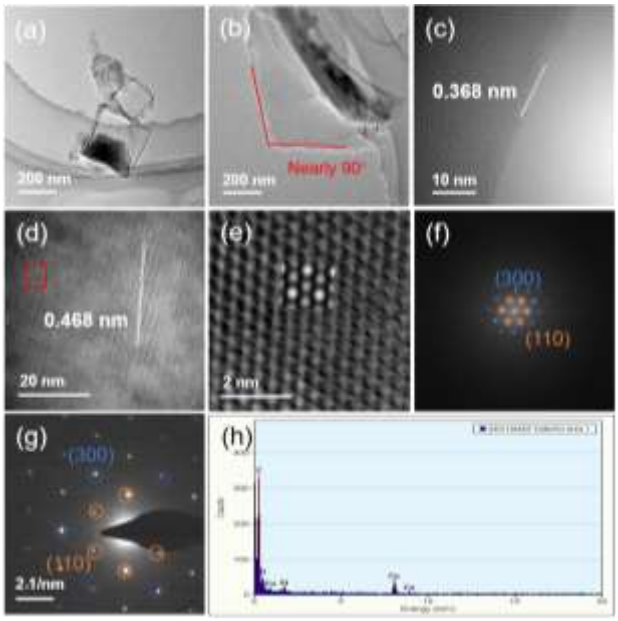

Figure 2: Structural characterization of GDY film.