

Large-area deposition of few-layer graphene produced by liquid phase exfoliation of expanded graphite

M. Bodik, D. Kostiuk, P. Siffalovic, M. Hodas, M. Pelletta, M. Jergel and E. Majkova

Institute of Physics, Dubravska cesta 9, 845 11 Bratislava, Slovakia
peter.siffalovic@savba.sk

Abstract

Liquid phase exfoliation of graphene [1] presents a promising route for large-scale graphene production. Herein, we describe controlled deposition of few-layer graphene (FLG) using modified Langmuir-Schaefer deposition. The FLG sheets were exfoliated from the expanded graphite by ultrasonic treatment or high-shear mixing in DMA, DMF and NMP solvents. Our studies confirmed better exfoliation rate for the expanded graphite when compared to natural graphite flakes. The FLG dispersions were further purified by centrifugation and mixed with chloroform to increase the spreading coefficient. The FLG dispersion was dropwise applied onto water surface in a Langmuir-Blodgett trough. The FLG surface coverage was monitored by the Brewster angle microscopy. The closed FLG layer was transferred onto different substrates such as Si wafers and float glass substrates using controlled removal of the water subphase. This deposition technology guarantees large-scale homogenous deposition of nanomaterials in general [2]. The structural, optical and electrical properties of FLG layers were inspected by the grazing-incidence X-ray diffraction and reflectometry, AFM, confocal Raman microscopy, imaging ellipsometry, optical spectroscopy and sheet resistance measurements. A typical AFM image of the deposited FLG film is shown in Fig. 1. The quality of the prepared FLG films is superior to the films prepared by more conventional techniques such as spin- and/or dip-coating. The utilization of the FLG films is wide, ranging from transparent electrodes to special interface hole transport layers for organic electronics.

References

- [1] K. R. Paton et al., *Nat Mater* **13**, 624 (2014).
- [2] P. Siffalovic et al., *Self-Assembly of Nanoparticles at Solid and Liquid Surfaces*, chapter in "Smart Nanoparticles Technology" edited by Abbass Hashim, ISBN 978-953-51-0500-8, InTech (2012)

Figures

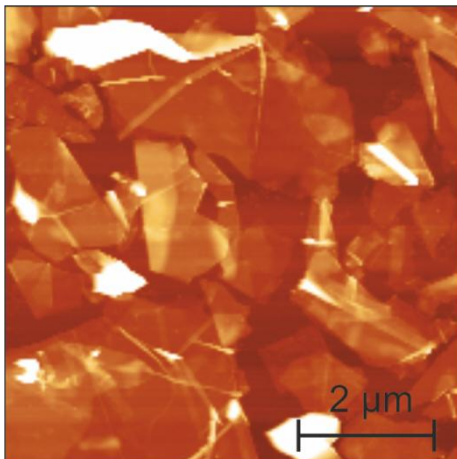


Fig. 1 - Densely packed FLG sheet after deposition.