

Direct exfoliation of graphite in water solutions

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Abstract

Graphene, because of its unique electrical properties, is the material with a wide range of potential applications, e.g. in supercapacitors, transistors and batteries. There are two main criterions, that should be fulfilled to make the process economic: quality and amount of obtained graphene. CVD method provide material with good electrical conductivity but it cannot be a mass production. On the other hand, chemical reduction of graphene oxide is the most quantitatively effective, but such obtained sheets have poor electrical conductivity. The most perspective way for the electronic applications seems to be direct chemical exfoliation of graphite. Such process is carried out in organic solutions or in water with surfactants and must be ultrasound-assisted. These molecules penetrate the layers in graphite causing the separation of graphene sheets and preventing from aggregation. The one serious disadvantage of direct exfoliation is the usage of toxic organic solvents [1]. There are some experiments with water-solution exfoliation of graphite [2].

In this work the results of direct exfoliation of expanded graphite are presented. Medium for the process were water solutions of chitosan dissolved in two different solutions and with sodium deoxycholate (SDC). These are non-toxic compounds. As a consequence, graphene composites with different morphologies were obtained (Fig.1. a, b). Medium for the exfoliation has significant influence on the thickness of graphene sheets, electrical properties and the amount of defects in graphene structure, what can be seen on Raman spectra. The best sheet resistance of obtained samples was below 1 Ω /sq. Raman measurements indicated no or small amount of defects in this few-layer graphene. AFM images prove good separation of graphene layers from graphite and the thickness of platelets obtained by exfoliation was about 2 nm (Fig. 2).

References

[1] Changqing Liu et al., J. of Supercritical Fluids, **63** (2012) 99-104

[2] H. Yang et al., Carbon **53** (2013) 357-365

Figures

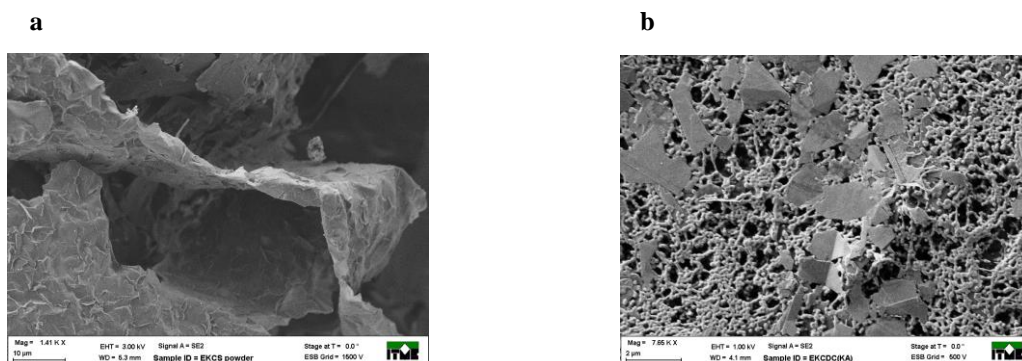


Fig.1 SEM images of composite of graphene/chitosan dissolved in two different solutions (a- dried, b- imposed on the silica plate).

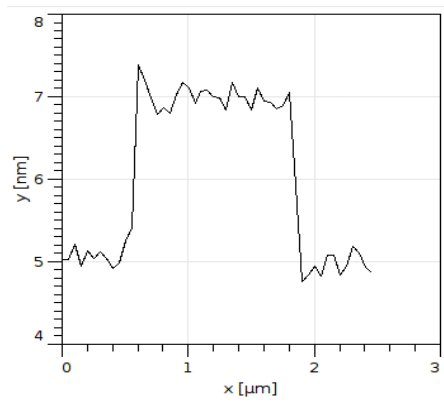


Fig.2 AFM profile of graphite exfoliated with SDC.