

# Nanocomposite and nanomaterials

## Low-temperature reduction of Graphene Oxide

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Reduced graphene oxide (GO) is very promising 2D material for fabrication of high conductive transparent thin films [1]. However up to now reducing of this material was performed in vacuum or in some special atmosphere at enough high temperature (more than 400C) [2]. In this work we study the electrical and structural properties of GO films after their thermal reduction at temperature not more than 250C. The GO was synthesized by Hummers' method and transformed into water solution. The GO films were obtained by drying of the deposited solution on glass wafer. Thermal heating was performed in temperature range from 100 to 500°C in room atmosphere. Deposited and annealed samples were measured by 4 probe method, micro-Raman spectroscopy (mRS), FTIR spectroscopy, AFM and optical microscopy. It was shown that in narrow temperature range from 100 to 220°C a resistance of the GO films strongly decreased (from  $4 \times 10^{11}$  to  $3 \times 10^6$  Ohm sq) and did not change the last value for next weeks. During such strong transformation of the electrical conductivity we detected extraction of water molecules and OH bonds from the material and formation C=O and C-O-C bonds (FTIR). The mRS demonstrates formation of D\* phonon line at  $1120 \text{ cm}^{-1}$  which is associated with  $sp^3$  rich phase of disordered amorphous carbons. AFM shows some destruction of the GO surface and formation some microbubbles which could be linked with evaporation of molecule water. The origin of observed phenomenon is discussed.

1. Zhu Y., Murali S., Cai W., X. Li, J. W. Suk, Potts J. R., Ruoff R. S. Graphene and Graphene Oxide: Synthesis, Properties, and Applications // Adv. Mater. – 2010.- 22.-P.3906–3924.

2. Pei S., Cheng H.-M. The reduction of graphene oxide // Carbon.-2012.- 50.-P. 3210-3228.