Resistive switching in reduced graphene oxide

M. Rogala[1,2], P.J. Kowalczyk[1], W. Kozłowski[1], L. Lipińska[3], J. Jagiełło[3], K. Librant[3], P. Dąbrowski[3], J.M. Baranowski[3], K. Szot[2] and Z. Klusek[1]

[1] *Department of Solid States Physics, Faculty of Physics and Applied Informatics, University of Lodz, Pomorska 149/153, 90-236 Lodz, Poland*
[2] *Peter Grünberg Institut and JARA-FIT, Forschungszentrum Jülich, 52425 Jülich, Germany*
[3] *Institute of Electronic Materials Technology, Wolczynska 133, 01-919 Warsaw, Poland*

A resistive switching (RS) mechanism relays on electrically inducted reversible changes of the material resistivity between two distinguishable states of low (ON) and high (OFF) resistance. It was mainly studied in metal oxides [1], however, recently it turned out that the RS can be also observed in graphene oxide (GO) [2]. This discovery seems to be of high importance due to potential application of the GO in flexible and transparent electronics in particular in a novel resistive random-access memory modules. Interestingly, the origin of the switching phenomena in GO is not fully recognized up to date.

In our presentation we show that the RS can be observed not only in GO but also in reduced GO (rGO). We used here the rGO produced by oxidation-reduction method. The starting material - expandable graphite from Asbury Carbons was oxidised using modified Hummers method followed by the chemical reduction using simultaneously two inorganic compounds in the presence of sodium deoxycholan. The reduction process used here was found to prevent the agglomeration of carbon flakes. Obtained in such a way noncovalently functionalised rGO was deposited from water solution on p-doped silicon wafer using drop cast method which resulted in the resistivity rGO layer at the level of 300 Ωcm^2.

We conducted our experiments both in macro- and nanoscale. For macroscale measurements various metals were used as an electrode material. Electrodes were contacted to the rGO layer, which gave us the opportunity to record I(V) characteristics. The measurements were conducted in air at room temperature (RT) and also for a sample rinsed in liquid nitrogen and with a droplet of water in electrode contact area. The nanoscale measurements were conducted in air and at RT using atomic force microscope (AFM) with conducting platinum coated tip. All the measurements showed presence of the RS, however, there are clear differences dependent on the electrodes material, temperature and environment in which the experiment was carried out. What is more, we show that in rGO both unipolar and bipolar RS is possible.

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