PROPERTIES OF MILDLY OXIDIZED GRAPHENE AND PROSPECTS FOR ITS APPLICATION IN ELECTRONICS*

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The creation of mildly oxidized water-based graphene suspensions without additional additives makes it possible to create graphene films with high conductivity and good quality, which is currently in wide demand. Suspensions of mildly oxidized graphene are applicable for creating elements of electronic structures on flexible substrates using printing technologies.

In this work, mildly oxidized graphene was synthesized by electrochemical exfoliation of graphite in an aqueous solution of ammonium sulfate. We obtained flakes of mildly oxidized graphene with thicknesses in the range of 0.4–2.0 nm, with average lateral dimensions of ~0.1 μm and with a content of oxygen atoms of ~20%. The reduction of mildly oxidized graphene was carried out using laser radiation with a wavelength of 474 nm at an energy density of 108 J/cm2, which led to a decrease in the content of oxygen atoms to ~1.7% and the achievement of the surface resistance of mildly oxidized graphene films to tens of Ohms/□.

Using mildly oxidized graphene, humidity sensor and capacitor structures were created on flexible polyethylene terephthalate substrates using the screen printing method. The structures, which are a vertical capacitor, have an average capacitance of ~6 μF, which is stable when substrates are bent up to a radius of 6 mm. Cotton-based conductive electronic fabrics impregnated with chemically reduced mildly oxidized graphene with a resistance of the order of ~103 Ohms have been obtained. Based on the resulting textiles, sensors for temperature, humidity, bending and human pulse were created and studied (Fig.1).

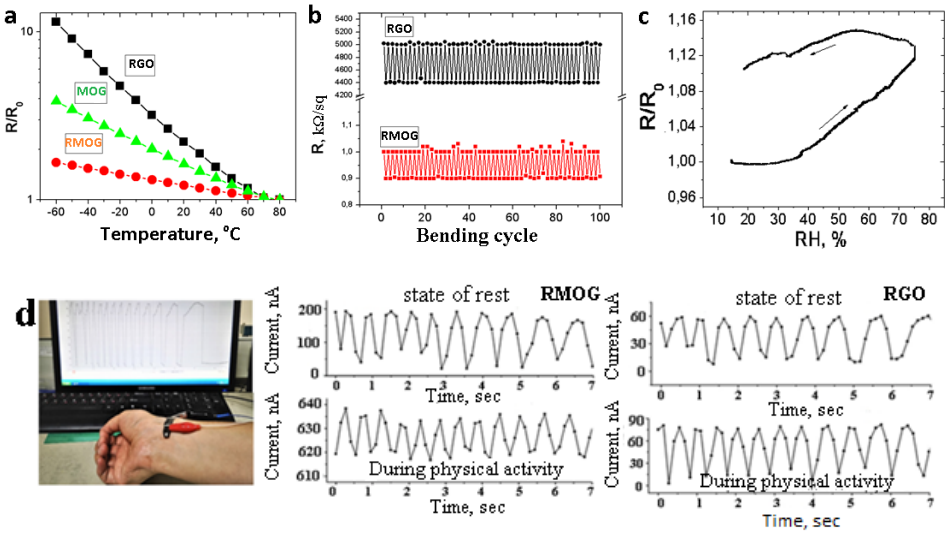

Fig.1. Dependence of the resistance of conductive textiles on temperature (a), on bending cycles (b), on humidity (c) and on pulse (d)

It has been shown that the sensitivity of tissue temperature sensors depends on the content of oxygen atoms in mildly oxidized graphene, while pulse sensors do not have such a dependence.

Mildly oxidized graphene is a promising material for printing technologies and wearable electronics.

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