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Reduced graphene oxide for energy harvesting and storage

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The need for clean and sustainable energy sources to meet the exponentially rising energy demands of the world has compelled scientists to look for new power generation strategies. Photovoltaic and thermoelectric (TE) energy conversion is proved as an alternative route to obtain electric power economically and to harvest widely distributed waste heat, respectively [1,2]. At the same time the renewal of interest to fundamental mechanisms of energy storage in electrochemical supercapacitors (SCs) was boosted by the progress in development of novel materials (mainly carbon based) for nanostructured electrodes [3]. SCs can be charged faster than batteries, leading to a very high power density, and do not lose their storage capabilities over the time. The main shortcoming of SCs is their low energy density, meaning that the amount of energy, which SCs can store, per unit weight is very small, particularly when compared to batteries. There is a wide range of the materials for electrodes and electrolytes but all of them have limitations. Preliminary design criteria and cell specifications are following: flexible, low weight and cheap. Thus, obtaining the freestanding electrodes by simple vacuum filtration will decrease the total weight of full cell device and total cost.

At the same time, reduced graphene oxide (rGO) has attracted significant attention in recent years due to its extraordinary physical and chemical properties [3]. Thanks to the combination of the excellent mechanical properties and compositional tunability, rGO-based materials are exciting systems for their potential applications [4,5]. Within this context, use of rGO in solar cells, TE generators and electrodes for SCs is very perspective and needs to be further investigated. In the current work structural and microstructure properties, as well as electrical, TE and electrochemical characteristics of rGO-based films and papers are presented and their relation is studied.

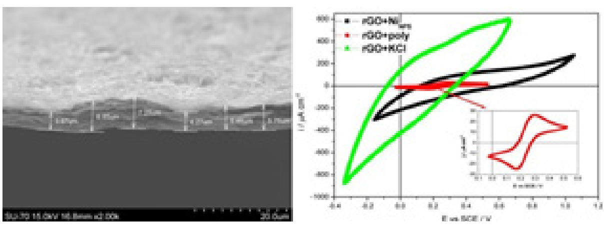

Figure 1: Scanning electron microscopy image (left) and electrochemical characterization (right) of rGO-based paper with Ni nanparticles (rGO+NiNPs), polycarbonate (rGO+poly) and potassium chloride (rGO+KCl) additives