

Nanocomposites and nanomaterials

Supercapacitors based on novel graphene containing electrode material

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Since graphene was isolated from graphite by Novoselov and co-workers [1], this material has been thoroughly studied in the scientific community for various applications. However, despite the huge number of research publications, the real practical application of graphene is still rather modest. This can be accounted for the following reasons: lack of graphene mass-production, high cost and low quality of samples, interaction between single graphene sheets resulting in their aggregation, and problems related with storage [2]. Nevertheless, some promising examples are known [3,4], wherein graphene has been used as an electrode materials in energy storage systems (ESS), in particular, in supercapacitors.

In our work the performance of graphene, when being used as electrode material in supercapacitors, has been studied. Due to its huge theoretical specific surface area of $2,675 \text{ m}^2 \text{ g}^{-1}$, graphene should be a perfect candidate for boosting the energy density of ESS, however, we did not observe any improvement in real supercapacitor prototypes. On the other hand, graphene can be used as an additive to other electrode components for increasing the ESS power density.

The optimum ratio of the components in graphene containing electrodes was found with the use of various electrochemical techniques such as galvanostatic cycling, cycling voltammetry and electrochemical impedance spectroscopy.

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3. *Miller, J. R., Outlaw, R. A & Holloway, B. C.* Graphene double-layer capacitor with ac line-filtering performance. // *Science*. – 2010 – **329**. – P. 1637–1639.
4. *Yoon, Y. et al.* Vertical alignments of graphene sheets spatially and densely piled for fast ion diffusion in compact supercapacitors. // *ACS Nano*. – 2014. – **8**. – P. 4580–4590.