SNO_2/RGO COMPOSITES AS ANODE MATERIALS FOR LITHIUM-ION BATTERIES

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Lithium-ion batteries have become the most popular chemical sources of power to supply cell phones as well as electric cars. Their main advantages include high energy density, low self-discharge and long lifetime. However, graphite that presently is the most often used anode material in Li-ion batteries, may soon not be able to meet the growing demands on the efficiency and safety of work of such power sources [1-2]. A promising alternative to graphite is SnO_2 because of its high theoretical capacity, nearly twice higher than that of graphite, (781 mAh/g), low cost of production and relatively low potential needed for intercalation process. The SnO_2 -based anodes have not been commercially used as yet because of the changes in volume while in operation, leading to stress and cracking of the material and finally to a fast decrease in the battery capacity. Attempts have been made to eliminate the changes in volume of SnO_2-based anodes and aggregation of SnO_2 molecules through e.g. production of porous structures, formation of SnO_2/graphite composites or covering SnO_2 with a carbon layer. The best solution of the hitherto proposed ones is addition of graphene to the mass of SnO_2-based active electrodes [3-8]. Graphene is an allotropic variety of carbon, built of a single layer of carbon atoms linked through six-membered connections. It is light, exceptionally hard but at the same time elastic and of greater mechanical strength than steel.

The aim of our study was production and comprehensive physicochemical and electrochemical characterization of hybrid electrode materials based on tin dioxide and reduced graphene oxide (SnO_2/RGO), proposed as advanced electrode materials for ecological storage of energy – lithium-ion batteries. SnO_2 was synthesized by a “one pot” method, which permitted elimination of the toxic chemical compounds usually used in the syntheses of tin dioxide. GO was synthesized by two methods and GO reduction to RGO was made by thermal and chemical methods. The results permitted proposing a technology for the production of hybrid anode material on laboratory scale using the methods that are cheaper and much less harmful to the natural environment. The parameters characterizing the obtained hybrid materials are the promising premises for further research aimed at obtaining SnO_2-based anodes characterized by high theoretical periodicity and stability of work.

References:

[1] W. Li, D. Yoon, J. Hwang, W. Chang, J. Kim, J. P. Sources, **293**, (2015) p.1024.
[2]J.M. Tarascon, M. Armand, Nature, **41**, (2001) p.4359.
[3] B. Luo, Y. Fang, B. Wang, J. Zhou, H. Song, L. Zhi, Energy Environ. Sci., **5**, (2012) p.5226.
[4] M.V. Reddy, G.V. Subba Rao, B.V.R. Chowdari, Chem. Rev., **113**, (2013) p.5364.
[5] P.G. Bruce, B. Scrosati, J.-M. Tarascon, Angew. Chem. Int. Ed., **47**, (2008) p.2930.
[6] X.W. Lou, C.M. Li, L.A. Archer, Adv. Mater., **21**, (2009) p.2536.
[7] S. Shi, T. Deng, M. Zhang, G. Yang, Electrochim. Acta, **246**, (2017) p. 1104.

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