

Nanocomposites and nanomaterials

Synthesis and investigation electrical properties of novel Li-conducting materials of the system $(\text{La}_{0.5}\text{Li}_{0.5})[\text{Nb}_{2y}\text{Ti}_{1-y}]\text{O}_{3+3y}$

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Li-ion batteries have been used successfully in different devices, such as hybrid electric vehicles, mobile power and renewable energy storage. Currently one of the best crystalline inorganic solid-state lithium-ion electrolyte is lithium lanthanum titanate (LLTiO) with defect perovskite structure $\text{Li}_{0.5}\text{La}_{0.5}\square\text{TiO}_3$ ($0 < x < 0.16$) ($\sim 10^{-3}\text{S/cm}$, $T=290\text{ K}$) and lithium lanthanum niobate (LLNbO) $\text{Li}_{0.5}\text{La}_{0.5}\square\text{Nb}_2\text{O}_6$ ($\sigma \sim 10^{-4}\text{ S/cm}$) [1]. For improving the characteristics of Li-ion batteries it is necessary to increase the rate of diffusion of lithium electrode and cathode materials. The using of self-agglomerated nanoparticles could solve this problem. The increase of mobility of the lithium ions through decreasing the diffusion length in nanometer scale is possible by using nanoscale materials.

For ionic conductors with perovskite structure the ionic mobility from one vacancy to another through structural channels is possible due to the availability of vacancy. It is known that ionic conductivity is proportional to the concentration of mobile ions (n_c) and their mobility (μ) which increases with the increase of the number of vacancies (n_V). The ionic conductivity of the system LLTiO is limited by small amount of vacancies, and of the system LLNbO – by low concentration of conducting ions (lithium ion). The aim of this work is the synthesis of nanoparticles of systems of solid solutions of $(\text{La}_{0.5}\text{Li}_{0.5})[\text{Nb}_{2y}\text{Ti}_{1-y}]\text{O}_{3+3y}$ by sol-gel method, which will be characterized by high lithium ions conductivity.

Nanoparticles of lithium-conducting materials with size 20-50nm have been obtained. The ceramic bulk materials obtained base of nanoparticles characterized by higher conductivity compared with materials of the same composition obtained by other methods of synthesis.

1. Kobylianska S.D., V'yunov O.I., Belous A.G. and Bohnke O. Lithium Ion Conductors with Perovskite Structure // Solid state phenomena. – 2013. – **200**. – P. 279-285.