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Mesoporous Na2Ti3O7 Nanotube-Constructed Materials with Hierarchical Architecture: Synthesis and Properties

Authors : Neumoin Anton Ivanovich, Opra Denis Pavlovich

Abstract : Materials based on titanium oxide compounds are widely used in such areas as solar energy, photocatalysis, food industry and hygiene products, biomedical technologies, etc. Demand for them has also formed in the battery industry (an example of this is the commercialization of Li4Ti5O12), where much attention has recently been paid to the development of next-generation systems and technologies, such as sodium-ion batteries. This dictates the need to search for new materials with improved characteristics, as well as ways to obtain them that meet the requirements of scalability. One of the ways to solve these problems can be the creation of nanomaterials that often have a complex of physicochemical properties that radically differ from the characteristics of their counterparts in the micro- or macroscopic state. At the same time, it is important to control the texture (specific surface area, porosity) of such materials. In view of the above, among other methods, the hydrothermal technique seems to be suitable, allowing a wide range of control over the conditions of synthesis. In the present study, a method was developed for the preparation of mesoporous nanostructured sodium trititanate (Na2Ti3O7) with a hierarchical architecture. The materials were synthesized by hydrothermal processing and exhibit a complex hierarchically organized two-layer architecture. At the first level of the hierarchy, materials are represented by particles having a roughness surface, and at the second level, by one-dimensional nanotubes. The products were found to have high specific surface area and porosity with a narrow pore size distribution (about 6 nm). As it is known, the specific surface area and porosity are important characteristics of functional materials, which largely determine the possibilities and directions of their practical application. Electrochemical impedance spectroscopy data show that the resulting sodium trititanate has a sufficiently high electrical conductivity. As expected, the synthesized complexly organized nanoarchitecture based on sodium trititanate with a porous structure can be practically in demand, for example, in the field of new generation electrochemical storage and energy conversion devices.

Keywords : sodium trititanate, hierarchical materials, mesoporosity, nanotubes, hydrothermal synthesis
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