VANADIUM-DOPED TITANIA MESOCRYSTALS

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The oriented and well-ordered structural material allows to enhance various functional properties, such as magnetic, mechanical, optical, etc. Ordered materials based on compounds from the TiO_2-VO_2 system, which have a unique electronic structural structure, are interesting from the point of view of application in photocatalyst, electrical engineering and optoelectronics. The TiO_2-VO_2 system has been studied in details in the form of thin films; however, the technology of film synthesis implies precise control of the oxygen pressure and the use of high-quality substrates. Alternatively a simpler method of obtaining such structures can be the use of anatase mesocrystals – ensembles of oriented TiO_2 nanoparticles obtained by self-assembly in a solution involving, for example, a polymer matrix.

Here at first we present the possibilities of obtaining mesocrystals $Ti_{1-x}V_xO_2$, the study of their microstructure, composition and functional properties. The proposed method of synthesis is based on the principles of "soft chemistry" and is simple and not expensive.

Synthesis of mesocrystals $Ti_{1-x}V_xO_2$ was performed by annealing the mechanical mixture of the previously obtained precursor NH_4TiOF_3 and NH_4VO_3 with a variable ratio of reactants. The obtained powders were characterized using various physicochemical methods: XRF (including with the involvement of synchrotron radiation), SEM, EDX, HRTEM, XPS, Raman spectroscopy. The photocatalytic and electrochemical properties of materials were investigated.

The possibility of obtaining the $Ti_{1-x}V_xO_2$ solid solution with x to 0.25 by the indicated method is shown for the first time. According to X-ray powder diffraction and Raman spectroscopy, the particles obtained have anatase structure. The highest photoactivity (k * 103 = 3.05 min-1) was observed in $Ti_{0.999}V_{0.001}O_2$ mesocrystals, which is more than twice the value of undoped titanium dioxide particles.

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