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The Surface Morphology of Nanoscale tin Dioxide Films Influenced by Precursor Properties

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Thin films of oxide materials with nano-sized grains are widely used as sensors in modern gas analyzers, the transparent electrodes for solar cells, catalysts of the oxidation processes. The well-known production methods for nanosize tin dioxide, as well as other metal oxides, for sensitive elements of sensors are liquid-phase chemical methods: sol-gel method, chemical precipitation from solution, etc. The basic process for such technologies is the decomposition of thermally unstable tin compounds to form tin dioxide as the final product. The small number of such compounds, as well as limited and contradictory literature data on their physical and chemical properties causes the necessity for selection of a suitable precursor for nanosized tin dioxide.

We have proposed a technique for obtaining SnO_2 films based on the method of chemical precipitation from solution using polyvinyl acetate (PVA) as structuring agents. Supposedly the different drying processes determine conservation of water molecules in the precursor complex which influences the structure and morphology of the resulting film. The principal goal of the present work is the investigation of the mentioned precursor's peculiarities influence on the surface morphology of the obtained tin dioxide films.

The studies of tin dioxide films' surface morphology obtained from two different precursor complexes had established a significant effect of even small differences in the process of obtaining of tin dioxide precursor on the morphology of the surface and structure.

It was found that differences in the drying process used in the production of precursor complexes' films are the significant factor in the topological features of the films. The main feature which defines this influence is the bound water in the precursor's composition.

At the complex thermal decomposition the water, which is in its composition acts as a loosener, which allows to obtain tin dioxide films with nanograins of different sizes, depending on the precursor's type. Consequently, the use of a complex containing a hydrated precursor should be preferable in obtaining nano-sized tin dioxide films with a well-developed surface, thus providing high sensitivity of its physical parameters to the environmental changes and, and therefore, widely used as sensors. In the tin dioxide films obtained by the proposed technology the plasmons effects, investigated in [1] were registered. These investigations gave the possibility to determine optical parameters and structural peculiarities of the films.

1. V.S. Grinevich, L.M. Filevska, I.E. Matyash, L.S. Maximenko, O.N. Mischuk, S.P. Rudenko, B.K. Serdega, V.A. Smyntyna, B. Ulug. Thin Solid Films 522 (2012) 452–456.