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Obtaining the conductive SnO_2 films by chemical bath deposition method

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Abstract

Thanks to such unique properties as transparency and conductivity tin dioxide often utilize as transparent contact layer to produce displays, solar cells, and sensor devices. Hydrochemical method of deposition SnO_2 films is a perspective due to its simplicity, and economical efficiency. The ionic equilibria analysis was carried out and the boundary conditions of $Sn(OH)_2$ solid phase formation in the «Sn^{2+} – H_2O – OH^-» system calculated. It was established, that tin(II) hydroxide may be obtain in the range 2 < pH < 12. Preliminary results allow to determinate an optimal mixture sourness interval 1 < pH < 5. Revealed, that the thickness of the $Sn(OH)_2$ films strongly depends on the solution pH. Maximum value of 488 nm reached at pH = 8. Conductive SnO_2 layers were obtained on a glass and sitall substrates with simultaneously presence of antimony chloride and ammonium fluoride followed by annealing in air. The thickness vs temperature and thickness vs tin initial salt concentration dependences were installed. The uniform tin hydroxide layers with a thickness of ~74 nm may be synthesized under pH = 2 conditions. By the electron microscopy method the average particle size was established changing from 200 to 400 nm for as-synthesized films, to ~20 nm for annealed which indicates the nanostructure nature of the films. The morphology, elemental composition and conductive properties of deposited films were investigated before and after heating stage. Studying the annealing temperature influence at the film resistance were identified a three temperature ranges within which the films sharply differ in their conductive properties, which is associated with phase and structural transformations in them. Shown, that the most conductive SnO_2 films with the omic resistance 3-5 kOm/sm were obtained at the temperature range 620-870K.

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