SnS DEPOSITION BY CHEMICAL SOLUTION ROUTE

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Tin and sulfur binary compounds (Sn_xS_y) represent a rising class of electronic materials, that have been studied for some decades [1]. These materials are semiconductors. From all of tin sulfides, SnS is the most popular, because of non-toxicity [2], good chemical stability [3], high absorption coefficient [1], and typical p-type conductivity [2]. In addition, SnS has a multiple nature because of different structures (orthorhombic and cubic) by changing chemical parameters [2, 4, 5]. Moreover, different phases have their individual bandgap energy; for orthorhombic around 1.13 eV and for cubic around 1.73 eV [2]. So it shows the possibility to change the bandgap energy by changing the structure of SnS. Because of easy synthesis, the abundance of precursor elements, good properties have a possibility to use in a lot of areas, such as capacitors [6], solar cells [7], optoelectronic devices [8] and etc.

For the preparation of tin sulfide were used two different solvents: acetone or ethanol. Firstly the calculated amount of $SnCl_2 \cdot 2H_2O$ was ultrasonically dissolved in 5 mL of solvent for 10 min. In a small beaker was added 8 mL of thioacetamide as a source of sulfur. Then 10 mL of ammonia water and 12 mL of triethanolamine as complexing agent of tin ions were added. The prepared solution was diluted with distilled water to 100 mL and then heated at 70 °C for 3 hours using a magnetic stirrer. The solution was then filtered. The obtained precipitate was washed several times and left to dry at room temperature. X-ray diffraction (XRD) studies were performed with a D8 Advance diffractometer operating with Cu K_α radiation (Ni filter) at 40 kV and 40 mA voltage.

The phase composition of obtained materials was determined by contrasting their XRD patterns with those of known minerals. XRD analysis shows that synthesized material consists of two orthorhombic forms: α-SnS (JCPDS number 39-0354), known as mineral Herzenbergite, and β-SnS (JCPDS number 32-1361). XRD results showed that the mixture of tin sulfides was obtained. The two most intensive peaks are clearly seen in the diffractograms: one peak is assigned to α-SnS at 2θ=26.6 °, and the other – to β-form of SnS at 2θ=31.76 °. There are no significant differences between the solvents used. Using acetone, the peaks are slightly higher, but the diffraction pattern shows that the material is more amorphous. From the obtained results it could be said that a chemical solution deposition is a good technique for SnS fabrication and both solvents are suitable for it.

References

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