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Thematic section: Hydrochemical synthesis of the metal chalcogenides thin. Part 35.

Hydrochemical deposition Cu_2S films by sodium thiosulfate

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Abstract

Copper sulfide(I) thin films find general application in Solar Cell, as sensitive detectors, switches and thermistors, having optimal values of width of the forbidden zone equal 1.2-1.8 eV. It is noted, that chemical bath deposition have significant perspective, because having a simple hardware design, allows to deposit thin films to dielectric surfaces of different configuration at temperatures below 100 °C. The analysis of publication indicates the domination ot the prescription approach to the chemical deposition of copper sulfide(I) thin films by sodium thiosulfate. In this work, a calculation method of estimating the formation of solid phases of metal sulphides and selenides, developed earlier and tested on a large number of metal chalcogenides, was used. The boundary conditions for the formation of copper sulfide(I) were determined at a temperature of 298 K in the reaction system "$CuCl_2$ – $NH_2OH{\cdot}HCl$ – $C_4H_6O_6$ – Na_2SeSO_3" with sodium thiosulfate like chalcogenizer. It is shown that the most preferable for chemical deposition of copper sulfide(I) is the acidic area (pH = 3-4). At the same time, the deposition conditions accompanying the formation of the sulfide, the impurity phase of copper hydroxide CuOH, were found. The use of sodium thiosulfate as a chalcogenizer, as well as the introduction of hydroxylamine hydrochloride, provides the creation of reducing environ with the conversion bivalent copper in monovalent condition and the formation of Cu_2S. With considering selected concentrations of the components of the reaction composition and pH in the considered system, through hydrochemical deposition have been synthesized polycrystalline layers of copper sulfate(I) of dark brown color, up to 200 nm in thickness which have good adhesion to a sittal substrate. Scanning electron microscopy established that the thin-film layer is formed from «petals» with size of 150-200 nm. The elements composition is established by the method of energy dispersive analysis. The deposited layers are characterized by a high stehiometry of the formula composition, and base on the results of thermo EMF method, they have a hole conductivity type.

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