Growth of MS (M= Pb and Hg) Thin Films by Sequential Chemical Bath Deposition (S-CBD) method

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Abstract

PbS with its direct band gap of 0.4 eV and its absorption coefficient continuously increasing from the infrared (150 cm^{-1} at 3 μm) through the visible region has been used in infrared detectors since the mid 1940's. Double layer thin films systems of Sb_2S_3/ HgS, As_2S_3/HgS etc. show anomalous photoconductivity, which is characterized by a spectral memory. The dark conductivity of these materials in thin film form is not constant in certain temperature rang but depends strongly on the wavelength to which the film was preliminary exposed. PbS and HgS having variable optical band gaps (Hgs = 2 eV and PbS = 0.37 eV) are promising semiconductor materials for IR detection. In solar energy field, PbS and HgS thin films were investigated for photothermal applications. PbS and HgS thin films were grown by the S-CBD method. The S-CBD method is a step wise process of chemical bath deposition. The basic difference between CBD and S-CBD is the growth mode. In CBD all the precursors are present at the same time in reaction vessel while in S-CBD the substrate is treated separately with each precursor and these treatments are separated by rinsing. The thickness of the film is directly controlled by the number of deposition cycles.

In the present work, preparative parameters are optimized to get good quality PbS and HgS thin films by S-CBD method and listed in following Table.

Sr. No.	Film →	PbS		HgS	
	Precursor	$PbCl_2$	Na_2S	$HgCl_2$	Na_2S
1	Concentration (M)	0.05	0.05	0.05	0.05
2	Complexing agent	EDTA	-	EDTA	-
3	pH~	5	12	4	12
4	Immersion time (sec)	15	15	20	20
5	Immersion cycles	30	30	30	30
6	Deposition temperature	27	27	27	27
7	Rinsing time (sec)	15	15	40	40

Their structural, optical and electrical characterization with various techniques is in progress.