

## Chemical deposition of large area Silver Sulphide films

Dhumure S.S.\*and Lokhande C.D.

\*Ramkrishana Paramhansa Mahavidyalaya, Osmanabad, 413501, MS  
Department of Physics, Shivaji University, Kolhapur, 416 004, India

**Abstract-** In this communication, we report on the chemical deposition of large area (50 cm<sup>2</sup>) of Ag<sub>2</sub>S films from an acidic medium using thioacetamide as a sulphur source. The effect of deposition temperature from 8 to 55°C was studied.

### INTRODUCTION

The films of Ag<sub>2</sub>S have been chemically deposited onto glass, stainless steel and titanium substrates, using thioacetamide as a sulphur source. The preparative parameters have been optimized. The reaction mechanism for deposition from acidic medium have been proposed. Thin, reflecting adhesive and polycrystalline Ag<sub>2</sub>S films were studied. The electrical resistivity, microstructure and XRD of the films have studied. Photo electrochemical cells showed that, the films are in type and photoactive in nature.

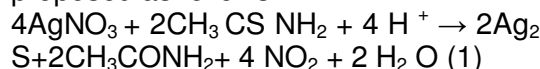
### EXPERIMENTAL

Aqueous solution (5 ml of 0.1M) silver nitrate and (15 ml of 0.5 M) thioacetamide were mixed together in a beaker. To it, glass substrates were immersed, after being attached to a holder and stirred continuously during deposition. The pH of the solution was 2.5. The solution colour was changed to blakesh and after 30 mins. Films were taken out of the bath, washed with double distilled water and preserved in an air tight container. The films were adhesive uniform to the substrates. In this study, for the deposition at 8°C the solution were cooled down at 8°C with ice bath, before mixing, the reaction mixture was placed in a constant bath temperature maintained at 8°C for 30 mins. Studies of the optical absorption of the films were carried out using UV-VIS - NIR spectrophotometer. The structure of the films was determined by X-ray diffraction pattern using

Cuka radiation with Philips pw 1710 diffractometer. The activation energies of the films were determined by measuring the dark conductivity from 300 to 575 k using two probe method using pressure contact.

### RESULTS AND DISCUSSION

Silver sulphide films have been deposited from acidic medium, using thioacetamide as a sulphur releasing source. The reaction mechanism is proposed as follows.



The film quality was improved at 27°C; the film thickness was increased with decreasing temperature. Fig. 1 shows Ag<sub>2</sub>S films deposited at 8°C bath temperature. The films were uniform and thin.



Fig. 1-shows Ag<sub>2</sub>S films deposited at 8°C x 375 (magnification)

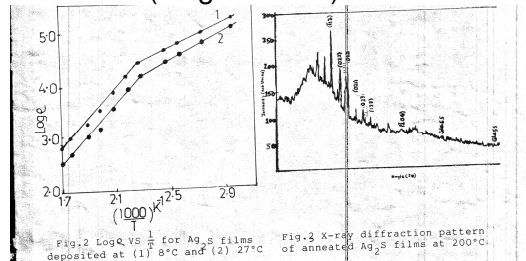


Fig. 2-

We have studied the electrical resistivity of the  $\text{Ag}_2\text{S}$  films deposited in the range 8 to 550°C. It was found that, resistivity for the deposition at 8°C bath temperature is of the order  $1-2 \times 10^5$  ohm cm. Fig. 2 shows the plot of  $\log \rho$  vs  $1/T$  for the  $\text{Ag}_2\text{S}$  films deposited at 8 and 27°C. The plots show two regions corresponding to low and high temperature regions. The value of activation energies in both the regions are 0.069 eV and 0.37 eV at 8°C and 0.10 eV and 0.24 eV at 27°C respectively. X-ray diffraction patterns were taken using a PW1710 diffractometer to examine the  $\text{Ag}_2\text{S}$  films. It shows that, the films are polycrystalline in nature. Fig. 3 shows x-ray diffraction pattern of annealed  $\text{Ag}_2\text{S}$  films at 200°C. The observed 'd' values of  $\text{Ag}_2\text{S}$  are in good agreement with standard 'd' values taken from the ASTM Diffraction Data File are given below.

Observed d values	Standard d values
2.832	2.836
2.573	2.583
2.434	2.440
2.412	2.421
2.379	2.383
2.076	2.072
1.962	1.963
1.556	1.554

Optical absorption of  $\text{Ag}_2\text{S}$  films was studied in the wavelength range of 900 to 2000 nm for the film. The absorption coefficient ' $\alpha$ ' was found to be of the order of  $10^4$  to  $10^5 \text{ cm}^{-1}$  above the band gap region. The  $\text{Ag}_2\text{S}$  films were n type in nature and showed photovoltaic activity in a photoelectrochemical cell formed with 1M (NaOH -  $\text{Na}_2\text{S}_2\text{O}_3$ ) electrolyte. The ISC  $\approx 0.1 \text{ mA/cm}^2$  and Voc  $\approx 100 \text{ mV}$  has been obtained at  $100 \text{ mW/cm}^2$  illumination intensity.