Photoelectrochemical activities of lead sulfide semiconductor prepared by cyclic voltammetry

M. Jafarian 1, F. Razzaghi, M. G. Mahjani
Departement of chemistry, K. N. Toosi University Of Technology, P. O. Box 15875-4416 Tehran, Iran
Corresponding author.
E-mail address: mjafarian@kntu.ac.ir (M. Jafarian).
Tel: (009821) 22853551 Fax: (009821) 22853650

Introduction

The tremendous amount of research that has been carried out in the field of semiconductor photoelectrochemistry and inorganic solar cells during the past three decades continues to provide fundamental insights and practical applications[1].

Lead sulfide is narrow band gap semiconductor with band gap energies of 0.41 ev. Many useful applications [2] such as photodetectors, optoelectronic devices and solar cells have been cited by various researchers.

We try to investigate about electrochemical preparation of PbS, it’s properties as an photoelectrode under light irradiation. For this reason a convenient electrochemical method to prepare PbS in aqueous phase on the electrode surface is cyclic voltammetry technique.

Keywords: Photoelectrochemistry; Solar cells; Semiconductor electrode; cyclic voltammetry; Lead sulfide

Experimental

Electrochemical studies were carried out in a conventional three electrode cell powered by an electrochemical system comprising of EG&G model 273 potentiostat/galvanostat. The system is run by a PC through M270 commercial software via a GPIB interface. A sheet of lead foil, graphite, and Ag/AgCl were employed as working, counter and reference electrodes, respectively.

The aqueous electrolyte solution consisted of 0.1 M NaOH, 0.25 M Na2S. The potential range was between -0.1-1.3 vs. Modification of Pb electrode with PbS is done by applying 1.3V vs Ag/AgCl in 100s.
Results and discussion

We studied PbS behavior as a semiconductor in dark and under light irradiation using cyclic voltammetry for analyzing. We observed Pb was oxidized to Pb$^{+2}$ during the potential cycling which reacted with S$^{-2}$ to produce PbS and the current peak in cyclic voltammogram is increased after irradiation (Fig.1). This phenomenon shows PbS behavior as a semiconductor in photoelectrode. Other interesting results we obtained by more analyzing shows the ability of PbS as a narrow band gap semiconductor, for use in photoelectrochemical cells, solar cells, and other optoelectronic devices. The plot of peak current versus square root of potential scan rate is linear and observed in figure 2. As can be seen the slope of the linear plot in light is higher than dark.

![Figure 1. Cyclic voltammogram of PbS with scan rate 200 mV/s.](image1)

![Figure 2. plot of anodic current versus square root of scan rate.](image2)

References:

1. Y.V. Kuzminskii, G.Y. Kolbasov, Solar Energy Materials and Solar