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Pyrite thin film growth by spray pyrolysis

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ABSTRACT

Pyrite (FeS_2) thin film was deposited on a glass substrate at 400^0C, using ($FeCl_2.4H_2O$) and thiourea as the precursors. Morphological, chemical and optical properties of the pyrite thin film were studied. Scanning electron microscopy (SEM) image showed the substrate was well covered by the pyrite thin film and more magnification revealed the morphology of the surface was homogenious. Energy dispersive spectroscopy (EDS) confirmed that the composition is near stoichiometric. Optical analysis showed the pyrite thin film is a potential absorber in UV-VIS range and the band gap value was calculated 1.2eV.

Keywords: Pyrite, Spray pyrolysis, thin film absorber

1. INTRODUCTION

FeS_2 is one of the metal- chalcogenide compounds which has attracted many attentions due to its appropriate optical and electrical properties. These properties have make pyrite a suitable material for applications such as field-effect transistors [1] and photovoltaic devices [2]. Pyrite (FeS_2) thin films have a remarkable absorption coefficient ($10^5 cm^{-1}$) and a proper band gap (0.9eV) that make it a potential absorber layer in photovoltaic systems and solar cells[3, 4]. In addition, its composition is environmentally compatible and there are plenty of its components in nature[5]; It is notable that Fe is one of the most abundant and economic elements in earth crust[6]. Despite the high absorption coefficient, pyrite band gap is under optimum value (1.5eV). Many attempts have been exerted to enhance the properties of FeS_2 thin layers. Various methods were applied to prepare these layers such as sol- gel[5, 7], chemical bath deposition[4], Epoxy catalyzed sol–gel[7], spray pyrolysis [8, 9]and sulfur vapor transport[10, 11]. Among them, spray pyrolysis is a low cost method which is easy to control. Aim of present work is deposition and investigation of morphological and optical properties of FeS_2 thin film by spray pyrolysis technique.

2. Material and Experimental

Soda lime glass substrate was washed with double distilled water and ethanol, then was ultrasonically cleaned. Tin tetrahydrate ($FeCl_2.4H_2O$) with molar concentration of 0.2M and thiourea ($CS(NH_2)_2$) with molar concentration of 0.4M were dissolved in 50 ml of double distilled water. The precursor solution was mixed on a magnetic stirrer at the rate 300 rpm for 15 minutes. Nozzle to substrate distance was set at 35 cm, the solution flow rate was kept at 5 ± 1 ml/min and carrier gas pressure was constant at 4 bar. The substrate temperature was kept at 400^0C with $\pm 5^0$ C tolerance.