PREPARATION AND CHARACTERIZATION OF POST- DOPED NANO-STRUCTURED CuI:I THIN FILMS

NORHAFIZAH BINTI ABU BAKAR

FACULTY OF ELECTRICAL ENGINEERING

UNIVERSITI TEKNOLOGI MARA

MALAYSIA

ACKNOWLEDGEMENT

First of all, Thank to Allah, the Beneficent and Merciful for giving the chance and courage in completing this project smoothly. I would like to dedicate the special thanks especially for my supervisor, Prof. Engr. Dr. Mohamad Rusop Mahmood and PHD student, Miss Nur Amalina Muhammad for their advising, opinion, guiding and helping along the process for completing this project.

Besides that, I would like to thanks to others including the lecturers, electrical engineering community and the technicians at NANO- Electronics Centre (NET) Faculty of Electrical Engineering for willing to help and give me some advice to reduce the unexpected problems that are occurs along the period of my project.

I would like to acknowledge to NEST (NANO- SciTech Centre Institute of Science) for their support. Last but not least, I would like to thanks to my family for helping me and give courage in process completing this project. Thanks for the cooperative that has been given to me.

Norhafizah Binti Abu Bakar

Faculty of Electrical Engineering

Universiti Teknologi MARA (UiTM)

40450 Shah Alam

Selangor Darul Ehsan

ABSTRACT

The undoped and iodine doped CuI thin films with diffirent doping concentration were synthesized by using mister atomizer technique. The CuI solutions were prepared using CuI powder with acetonitrile as a solvent. The quantity of iodine was varied with 10, 20, 30, 40 and 50 mg. The results are observed on the properties of surface morphology, electrical and optical. The surface morphology characterized by FESEM revealed that the microstructure of CuI films depended on the relative amount of doping iodine in the solution. The surface morphology in the presence of iodine was closely packed spherical CuI grains. The surface morphology of undoped CuI thin films was found in larger faceted grains with a uniform distribution meanwhile the grain sizes for doped CuI thin films was found to be decreased. The resistivity of about 10^3 Ω cm^{-1} is observed in 40 and 50 mg CuI thin films. The optical transmittance was found to be in range 0.2% to 2.4% at various doping concentration. The result indicates that all CuI films exhibit low transmittance in the visible region than in the near infra- red region. The optical band gap was recorded between 2.14 eV to 2.96 eV at various doping concentration. The optical band gap for undoped CuI thin films was found to be at 2.92 eV which is less than the reported band gap by the literature which is 3.1 eV. However, at 40 mg of iodine gives the best value which is 2.14eV less than the undoped CuI thin films. The PL intensity peaks was observed at 420 nm, between 680 to 685 nm and between 835 to 840 nm. The nature of the photoluminescence is discussed and it may be due to the recombination that occurs from the excess of iodine.

Keywords: Copper (I) Iodide; Mister Atomizer; FESEM; Electrical; Optical

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.0 BACKGROUND OF THE STUDY

Recently, Copper (I) Iodide has been used to construct fully solid- state dye-sensitize solar cell (DSSC) [1]. CuI is a material that belongings to the group I-IIV in periodic table (APPENDIX 1) which has unique features such as negative spin orbit splitting, unusually large temperature dependency, anomalous diamagnetism behavior and new high pressure phases [2, 3]. Besides that, CuI is a p- type semiconductor that has large band gap about 3.1eV with an exciting binding energy of 62meV which is larger than the mean thermal energy at room temperature of 25meV [4].

Due to these unique features, there are many reports regarding the preparation and characterization of CuI films with several deposition techniques. T. Tanaka et al. studied the electrical and optical properties of CuI thin films deposited by rf- dc coupled magnetron sputtering technique [5]. CuI films deposited by pulse laser have been studied by P. M. Sirimanne et al [6].

In this study, CuI thin films will be deposited by using spraying technique with a system called as mister atomizer. This technique is the same concept of spray pyrolysis which use atomizer to convert the liquid solution into the form of mist. This deposition method produce the uniform distribution of diameters and controllable and purity of the products produce is high. The inexpensive of cost also added an advantage in this deposition technique since no vacuum condition needed as well as able to give high