CHAPTER 1

INTRODUCTION

1.1 Background of the Research

Zinc oxide is a type of metal oxide that owns an excellent property that have 100% internal quantum efficiency compared to other metal oxide (Touam et al. 2015). Zinc is one of the transition metal that is known as metallic in nature. Electrons in the outermost shell of ZnO are located in d-orbital where it is loosely bound, in other words; it is incompletely filled with electrons so they can easily give and take electrons. It also contributes to high electrical conductivity performance. There are various types of ZnO compound that can be formed due to its various oxidation state of transition (Hosseini et al. 2015). Zinc oxide thin film is extensively studied due to its potential application in various fields such as gas sensor, piezoelectric transducer, ultraviolet (UV) photoconductive detector, light emitting diode, laser system and solar cells. ZnO thin film is ought to surpass the performance of indium oxide and tin oxide where it can be deposited in low temperature and also good chemical stability under hydrogen plasma process while Indium oxide and tin oxide film greatly limits its practical application in solar cell (Zhang et al. 2011). Moreover, indium and tin are rare elements and highly cost. Zinc is also much preferable because indium and tin are toxic and hazardous to the environment.

Zinc oxide thin film band gap has a value of 3.4 eV at room temperature, with high exciton binding energy of approximately ~60 meV. In addition, it also high in electron mobility (~200 cm²V⁻¹s⁻¹) with high transparency at room temperature, as a result of oxygen efficiency and direct wide band gap n-type semiconductor (Ali et al. 2015). Many research has been done to dope with ZnO like Mahdhi et al. (2014) where
the ZnO was doped with Ga by magnetic sputtering technique using nanocrystalline particles prepared by sol-gel method. It state that GZO thin films was useful for optoelectronic devices mostly in solar cell due to its properties which are low cost, have low resistivity, large grain size which give smooth surfaces and highly transparent in the visible wavelength region with average percentage of transmittance about 90%.

There are various types of synthesis methods that have been employed in preparation of ZnO thin film to produce a quality thin film with desire thickness and each technique has its own advantages and disadvantages. Magnetic sputtering is a commonly used method in preparation of ZnO thin film. However, the drawback of this method is the small coverage of area of coating film deposition and requires a complex and expensive vacuum technique.

Meanwhile, Chemical Spray Pyrolysis is also one of the common methods that been used in preparing the ZnO thin films. This method become one of the most attractive film preparation methods. As it can be used to deposit large area of thin films due to its convenience, simplicity and low cost of production. The quality of film may depends on droplet size and spray nozzle. Thus, it has been used for a long time (Kozhukharov & Tchaoushev 2013; Nehru et al. 2012). However, it is possible for oxidation of sulfides to occur when processed in air atmosphere but it may have difficulties in determining the growth of temperature.

In order to minimize the issue, sol-gel method is seen as the best option than other method. This method has garnered a lot of attention from researchers due to its simple, and direct method to produce zinc oxide thin film by dissolved the zinc acetate dehydrate (Zn (CH₃COO)₂·2H₂O) solution in ethanol. Commonly, the sol-gel technique for the preparation of ZnO thin films used a solvent of high boiling point, such as ethylene glycol and monoethanolamine (MEA) or solvent of low boiling point, such as ethanol, isopropanol or diethylamine (DEA) (Mansoor et al. 2015). The sol-gel method has distinct potential advantages over other technique due to lower crystalline temperature, excellent composition control, conformal deposition ability and large surface area coating capability (Mansoor et al. 2015).
Spin coating technique has been used in many applications of thin films. Usually, the process requires the depositing a few drop of solution onto the surface of the substrate, then the substrate is spin at high speed of spin coater typically around 1000 rpm to 3000 rpm. Centripetal acceleration will cause the solution to spread equally on the glass slide. The film thickness will depends on the condition of solution either viscous or dilute and the parameters chosen for the spin process. The advantage of this method is ability to produce uniform thin films from nanometers to microns scale in thickness.

Meanwhile, the un-doped and doped zinc oxide thin films can be synthesized via sol gel method which has wide range of application as an important semiconductor material such as chemical sensor, electrical, gas sensors, luminescent devices or piezoelectric and solar cell (Musat et al. 2004). The optical and electronic properties of zinc oxide are greatly influence by chemical doping where Al, In and Ga-doped ZnO thin films have proven to be one of the most promising transparent conductive oxides for advanced applications such as displays and electro chromic devices (Wang et al. 2007).

Thus, this research is aim to synthesis the dopant effect on structural and optical of un-doped and silver-doped zinc oxide (SZO) thin film prepared by sol gel method. The parameter of this research is to use different amount (by drop) of silver doping on zinc oxide thin film and to determine which amount of silver produced a quality thin film.

1.2 Statement of the Problem

Immense interest has been focus on zinc oxide thin films due to the low cost and abundance source of raw material, comparable electrical, nontoxic feature and optical properties. There are various methods that have been reported to synthesize zinc oxide thin film such as magnetic sputtering, chemical spray pyrolysis, reactive evaporation and sol-gel method. However, only one method is chosen in conducting this research work due to its low cost, easy adjusting composition and dopant, easy adjusting composition and dopant which is sol-gel method (Nagarani et al. 2013). Sol-gel method