CHAPTER 1

INTRODUCTION

1.1 Background

Zinc oxide (ZnO) is an inorganic compound. ZnO appears as a white powder and nearly insoluble in water. The variety of products that needed the use of ZnO includes paints, plastic, ceramic, glass, cement, lubricants, ointments, batteries, adhesive and food products. ZnO is present in the earth crust as a mineral zincite, however most of ZnO used is produced synthetically.

In materials science, ZnO is also known as a good semiconductor and often called a II-VI semiconductor (Kooti, 2013). This is because zinc and oxygen belong to the 2^{nd} and 6^{th} groups of the periodic table. The properties that make ZnO a good conductor are high electron mobility, wideband gap, good transparency and strong temperature luminescence. These properties are used in emerging applications for transparent electrodes in liquid crystal displays and in energy saving or heat protecting windows. ZnO is also used as a thin film transistor and light emitting diode. ZnO is also considered as an important material for variety of applications in the visible and near ultra-violet region (Kooti, 2013).

ZnO nanoparticles have many advantages due to its size. Nanometer size ZnO has a wide technological applications such as photocatalysis reaction, quantum dot devices, solar energy conversion, biochemical sensors, chemical electrodes, cosmetic and pigments. ZnO nanoparticles have a good biocompatibility to human cells and their antibacterial (Ansari, 2011) and antifungal (Xie et al., 2011) activities have already been demonstrated.

ZnO has exhibited various kinds of nanostructures such as nanoneedles, nanobelts, nanoflowers, nanorods, nanobows, nanonails, nanoparticles and nanowires (Kooti and Naghdi, 2013). There are a lot of methods to synthesize ZnO nanoparticles which are

solution precipitation, spray pyrolysis, hydrothermal synthesis, sol-gel processes and micro emulsion synthesis (Barreto et al., 2013). Numerous reported synthetic methods for ZnO nanoparticles have been done in which most of them require high temperature, expensive substrates, tedious procedures, sophisticated equipment, and rigorous experimental conditions (Kooti and Naghdi, 2013). Hence, it is necessary to find out a simple and low-cost method. The methods of microwave heating is the most suitable methods to use.

The reason is because the synthesis is carried out in a thermostatic system and the wall of the reactor are heated by convection or conduction. This will results to the inhomogeneous temperature profiles which can be solved by microwave heating. Microwave heating can results to the rapid homogeneous heating of the reaction and the reaction occurs at the desired temperature which saves time and energy.

1.2 Motivation

The motivation to do this research is to find the most suitable method in producing ZnO nanoparticles. There are many methods to synthesize ZnO nanoparticles. Microwave method is chosen because it is a fast rate reaction and can reduce the use of energy in synthesizing the ZnO nanoparticles. The ZnO nanoparticles produce in this experiment will also be tested to analyze the quality and chemical properties.

The method that have been chosen is microwave heating methods for synthesizing ZnO nanoparticles. This method is one of the most efficient methods that have been used in synthesizing ZnO nanoparticles due to its rapid homogeneous heating of the reaction and the reaction occurs at desired temperature. The temperature can be determined by the microwave power and the best power could be at 600 W (Krishnavi and Thambidurai, 2013). In performing this method the production of ZnO nanoparticles will be an easy task to perform.

ZnO nanoparticles have been used in lots of industries and one of them is the food industry. Studying the effect on the bacteria can lead to new breakthrough in the industry. New

discoveries will contribute a lot the usage of ZnO nanoparticles and can further the ability that ZnO nanoparticles can do. The effect it have on microorganism can even be studied for medicinal purpose as it can affect the microorganism condition.

The research interest ZnO has increased in recent years. During the last decade the ZnO related research has increased rapidly since the emergence of the nanotechnology, the properties of ZnO such as electrical, mechanical, chemical and optical properties were studied with the reduction in size, which are largely believed to be the result of surface effects and the size of the ZnO nanoparticles.

1.3 Problem statement

A lot of methods have been done in synthesizing ZnO nanoparticles and finding the most proper method to synthesize the ZnO nanoparticles is crucial due to its high demand in a lot of industries. The need of good quality ZnO nanoparticles that will be used in the industries and easy to produced is some of the finding that have been done today. There are few researches were carried out on synthesizing ZnO nanoparticles. A studied the effects by (Barreto et al., 2013) of precursor reagents, temperature, irradiation time and types of additives on surface morphology of ZnO nanoparticles. The experiment was carried out through simple aqueous solution method.

Identifying the properties of ZnO produced is a must also to make sure that the production of ZnO is at a good quality. Some characterization methods have to be done to identify the ZnO quality and chemical composition. Industries have been producing and analyzing a lot of ZnO to make sure that they can produce a good quality of ZnO. This will be done to make sure that it can make us classify the ZnO synthesized into the criteria it poses.

A new and simple method was applied for the synthesis of ZnO nanoparticles with an average size of 20 nm (Kooti and Sedeh, 2012). In this microwave assisted combustion method, glycine as a fuel and zinc nitrate as precursor were used. ZnO produced was