CHAPTER 1

INTRODUCTION

1.1 Introduction:

According to many researches and experiments, scientists have found that it is possible to create new characteristics of materials by decreasing the dimensions of those materials. They also have found that Nanotechnology plays a very important role in that field. Actually, when the size of the materials dimensions are in the order of (10^{-9} m), there are many factors that affect the materials properties, such as; quantum-sizes effect, surface-to-volume ratio and boundary effect of fundamental structure. For example, continuous reducing the diameter of silicon nanowires from ~7 down to ~1.3 nm leads to gradual increases of the energy band gap of silicon from 1.1 ev up to 3.5 eV. In fact, this technology attracts intensive interests and attentions of many physicists and chemists. [1].

Nanotechnology, as it is defined in language dictionary, is a science of making or working with things that are so small that they can only be seen using a powerful electron microscope. Nanotechnology has very important applications in many fields including nano-physics; nano-chemistry; nanomaterials science; nano-biology; nano-electronics; nano-machining; and nano-mechanics. Nanomaterials are defined with at least one dimension between 1 and 100 nm. Nanomaterials can be classified into three groups according to the number of dimensions; zero-dimensional materials, one-dimensional materials and two-dimensional material. Table (1.1) will explain the characteristics of each type of Nanomaterials.

Nano materials classification	zero-dimensional materials	one-dimensional materials	two-dimensional materials
Number of dimensions which have Nanoscale size	materials with nanoscale size in all three dimensions	materials with nanoscale size in two dimensions	materials with nanoscale size in only one dimension
Examples	nanoparticles & nanoclusters	Nanowires, nanotubes, nanocables & nanobelts	Super thin films, multiple layer films & supper lattices

Table 1.1 the classification of nano materials dimensions.

Nanowires, which are considered as one-dimensional material, can be classified into two kinds: metallic nanowires and magnetic nanowires. Non-magnetic materials such as Pb and Au can be used to produce metallic nanowires while magnetic materials such as Fe and Ni are used to synthesis magnetic nanowires. [1] and [2].

Thermoluminescence dosimeters are one of the famous radiation detectors. They are sorted as a kind of detectors because they have been used in the radiation field to determine the amount of the radiation stored after exposed. For example, TLD (the short form of Thermoluminescence dosimeter) reader is used to measure the amount of radiation stored as Thermoluminescence emission for each trapped electron. There are many materials which are used as Thermoluminescence dosimeter, such as, lithium fluoride (LiF) and calcium fluoride (CaF_2) dosimeters. ZnS could also be considered as Thermoluminescence dosimeter because it has been found that ZnS crystals have high photoluminescence and thermoluminescence properties above room temperature [23]. ZnS crystals are widely used in opto-electronic devices because of their photoluminescence properties.

In this experiment the Zns particles will be used as Thermoluminescence dosimeter and its properties will be studied. ZnS crystals produced using vacuum evaporation or chemical techniques have thermoluminescence property emit light that can be best described by a "glow curve", which may present several glow peaks during a heating process.

This study will be divided into two parts. The first part is to synthesis ZnS nanoparticles and the second part is for tasting TL glow carves for the resultant ZnS nanoparticles. In this research, ZnS particles will be synthesized by method of thermal evaporation of Zn powder and S powder onto silicon substrates. The second method which is used to produce ZnS naon particles is by chemical precipitation method. ZnS:Mn nanoparticles will be synthesized by using solutions of three chemical compounds which are Zinc sulfate, Sodium sulfide and Manganese sulfate. The morphologies of resultant ZnS nanoparticles will be examined by FESEM, XRD and EDX. Finally the TL properties of ZnS nanoparticles and normal ZnS commercial powder will be studied. Then comparison between the results will be done. The ZnS nanoparticles will be used as dosimeter .

1.2 Objectives of the research:

1- Synthesis ZnS nanoparticles by method of thermal evaporation of Zn and S powders.
2- Synthesis ZnS and ZnS: Mn nanoparticles by method of chemical precipitation.
3- Comparing the TL of ZnS commercial powder with TL of ZnS nanoparticles.
4- Using ZnS nanoparticles as a TL dosimeter.

1.3 Outline of the dissertation

The first chapter of this dissertation gives a general view of nanoparticles also the chapter includes the objective of the research. Chapter two gives a description of Zinc Sulfide which includes crystal structures such as zincblende structure and Wutrzite structure, Physical Properties of Sulfur and Zinc and Bonding in II-VI compounds. Various techniques for synthesizing ZnS nanowires and prior approaches used to fabricate ZnS nanowires are also discussed. Finally characterization techniques such as transmission electron microscopy (TEM), scanning electron microscopy (SEM), Energy Dispersive x- ray Spectroscopy (EDS) and x- ray diffraction are discussed in this chapter.

Chapter three will include the methods which were used to synthesize ZnS nano particles using thermal evaporation and chemical precipitation techniques. The construction of the apparatus and preparation steps of ZnS nano particles will be explained. Chapter four shows the characterization of synthesized ZnS nano particles using high resolution scanning electron microscopy FESEM, XRD and EDX. The results and the discussion of ZnS and ZnS: Mn nano particles Thermoluminescence properties are presented in chapter five. Finally concluded the experiment results and gives some suggestions to enhance the Thermoluminescence properties of ZnS nano particles and to use this suggestions for further future studies.