FABRICATION OF ZINC OXIDE NANOFLAKES NITROGEN SENSOR

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Final Year Project Report Submitted In Partial Fulfilment of The Requirement
Bachelor Of Science (Hons) Industrial Physics
In The Faculty Of Applied Sciences
Universiti Technologi Mara (UITM)

January 2012

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ABSTRACT

In this study, sol-gel immersion method using Urea as stabilizer was proposed in order to fabricating Zinc Oxide nanoflake on gold-seeded Silicon substrate. The immersion time of samples was differentiate at at 12 hour, 24 hours, 36 hours and 48 hours.The ZnO nanoflake arrays formed on the substrate were characterized using field emission scanning electron microscope (FESEM) and Photoluminescence (PL) spectrum. Among 4 samples, ZnO36IT sample has good adhesion of morphology surface was detected. It expected to be a good sensor. The ZnO nanoflake then was used to produce Nitrogen, N_2 sensor base on their ability of good electrical and optical properties. The N_2 was chosen because it presence colorless, odorless at environment that can effect to humans and ecosystems. From PL spectrum analysis, the energy gap of ZnO nanaflake is fewer than bulk ZnO. The ZnO nanoflake has higher conductivity compared to bulk ZnO. Actually, the rate of concentration of N_2 flow inside container is consistent at 5.0 bubbles /second and means that the sensor is sensitive toward the rate of N_2 at 5 bubbles/ second. The sensitivity of a sensor can be measure using I-V testing. From the result, the higher sensitivity sensor is ZnO36IT sample with 90% sensitivity. Compared to others, their sensitivity is 87 % and 81% for samples ZnO48IT, ZnO12IT and ZnO24IT. Since the ZnO36IT sample has good adhesion of morphology surface, E_g of 3.1 eV, highest resistivity and sensitivity, it's enough to support it as a good sensor. Base on I-V testing graph, it has low voltage to sense a low concentration of N_2 flow inside container. In result, it has low power consumption.

CHAPTER 1

INTRODUCTION

1.1 Background

1.1.1 Zinc Oxide, ZnO

Zinc oxide is an inorganic compound with the formula ZnO. It usually appears as a powder and nearly soluble in water. In materials science, ZnO often called as II-IV semiconductor because zinc and oxygen belong to the second and sixth groups of the periodic table. Their properties are good transparency, high electron mobility, wide band gap, strong room-temperature luminescence. Those properties are already used in electronic applications of ZnO as thin film transistors and light-emitting diodes. As in group II-VI materials, the bonding in ZnO is largely ionic. Due to the polar Zn-O bonds, zinc and oxygen plane bear electric charge (positive and negative). The high heat capacity and high conductivity, low thermal expansion and high melting temperature of ZnO are beneficial for ceramics. ZnO has a large direct band gap of 3.37eV at room temperature. Advantages associated with large band gap include higher breakdown voltage, ability to large electric fields, lower electronic noise and high-temparature and high-power operation. It's also has a large excitation binding energy of 60 meV at room temperature. ZnO has a hexagonal closed-packed unit cell with dimensions a=3.25 Å and c=5.12 Å. ZnO can be present as a white powder, that produced in the laboratory by electrolyzing a solution of sodium bicarbonate with a zinc anode. The zinc hydroxide and hydrogen gas are produce during this process. Then, zinc hydroxide upon heating decomposes to zinc oxide.