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High Performance Humidity Sensor Based on ZnO Nanoparticles Synthesized by Co-precipitation Method

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Abstract. ZnO nanoparticles were successfully synthesized by a low cost co-precipitation method using zinc nitrate and sodium hydroxide as the raw materials. It was observed that the synthesized temperatures greatly effect on the size of ZnO nanoparticles. The lower synthesized temperatures resulted in the smaller nanoparticles. By adjusting the mole ratio of sodium hydroxide, the size of ZnO nanoparticles was also changed. The smallest ZnO particles was 47 nm obtained with 0.7 mole of sodium hydroxide. The smallest ZnO nanoparticles from each synthesized temperatures were fabricated as humidity sensor, showing an impressive performance under different relative humidity (17-94% RH). It should be noticed that the ZnO nanoparticles humidity sensor synthesized at 75 °C exhibited high response 2 times higher than that of synthesized at 95 °C. This is attributed to the higher surface area of ZnO nanoparticles for absorbed water molecule.

Introduction

Humidity sensor is an important device using in industry, biomedicine, automotive, agriculture and also for human comfort. To achieve a high stability, high sensing response, quick response, short recovery time and wide range humidity detection, many types of humidity sensors have been developed over the years. They are surface acoustic wave, capacitive, resistive and optical humidity sensors [1, 2]. Among these, most humidity sensors are either resistive type or capacitive type, and the resistive type humidity sensors showed many advantages, with a good long-term performance, low cost and a processing in mass product over the capacitive type humidity sensors [2].

Currently, ZnO an n-type semiconductor have extensively been investigated since ZnO own many impressive properties. It have been used for variety electronic devices including gas sensor [3], dye-sensitized solar cell [4] and also humidity sensor [5]. It was also reported that ZnO nanostructures humidity sensor exhibited a high stability over a long period test, small drift in hysteresis loops during adsorbed and desorbed water vapor and highly sensing response [5].

In this work, ZnO nanoparticles (*ZNPs*) were synthesized via a co-precipitation method since it is a simple method and does not need an expensive tools. Characterization and humidity sensing property of *ZNPs* was also carried out.

Experimental

ZNPs were synthesized via a low cost co-precipitation method using zinc nitrate ($Zn(NO_3)_2$, 99.9% Sigma-Aldrich) and sodium hydroxide (NaOH, 97% Sigma-Aldrich) as raw materials. Similar to our previous report [6], 0.1 M $Zn(NO_3)_2$ solution and 2 M NaOH solution were separately