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Au-decorated ZnO Nanowires for Selective Ethanol Sensing

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Abstract

Metal oxide semiconductors based on 1-D nanostructures such as nanorod, nanobelt and nanowire are promising candidates for gas sensing application due to high surface area to volume ratio [1]. ZnO is one of most promising metal oxides, it has a wide band gap (3.37 eV) and applies for gas sensing application [2]. In this work, ZnO nanowires were grown with vapor-liquid-solid (VLS) mechanism via thermal evaporation-condensation method using Au catalyst for structural evolution [1, 3, 4]. Particularly, the as-prepared ZnO sensing films were functionalized with Au catalyst by varying the sputtering time ranging from 0-15 s. The choice of Au catalyst comes from its important role in significant enhancement the gas-sensing properties. For the sensing results, all sensors were systematically studied towards NO_2, NH_3, C_3H_6O and CO, C_2H_5OH with different working temperature ranging from 250 to 400°C in dry and wet air. Nanowires functionalized with Au sputtering time at 5 s led to the highest response of 80.7 toward 70 ppm C_2H_5OH, which was higher than that of bare ZnO nanowire sensor (S=2.16) and those of the other gases at the optimal working temperature of 350°C with 30% humidity. Therefore, the sensor is a promising candidate as a sensitive and selective ethanol detector corresponding to threshold limit value and practical humidity effect for ethanol-sensing applications.

Keywords: Zinc oxide, Nanowire, Gold, C_2H_5OH, Gas sensor.

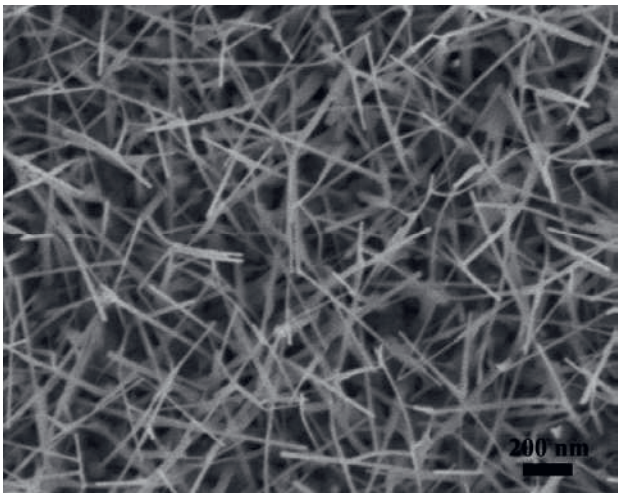

Fig.1. The typical SEM micrographs of as-prepared ZnO nanowires synthesized by vapor-liquid-solid (VLS) mechanism via thermal evaporation-condensation method using Au catalyst for structural evolution.

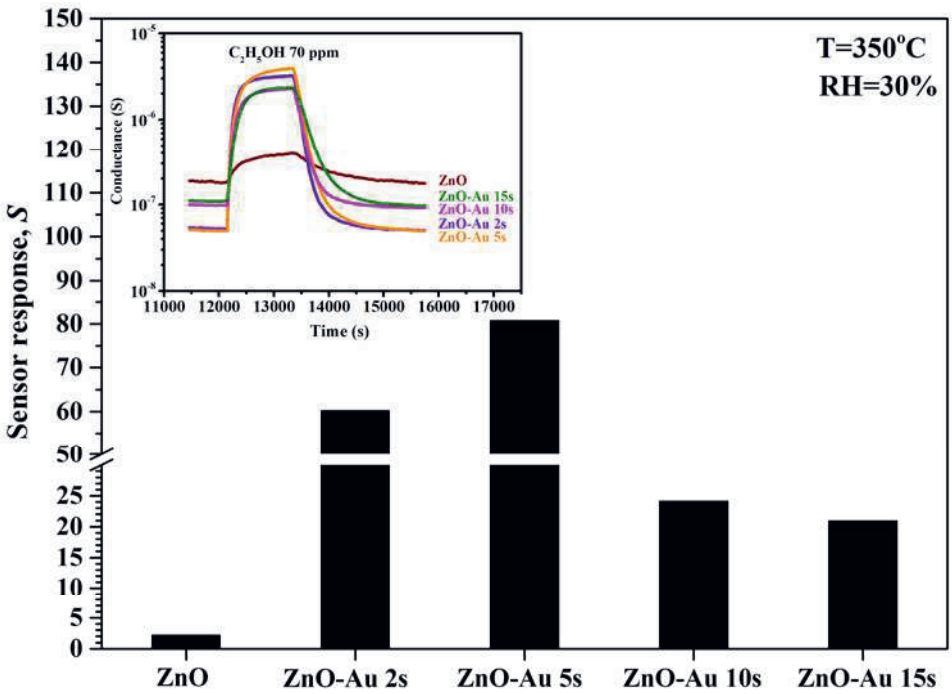

Fig.2. Gas-sensing properties of ZnO and Au-sputtered ZnO with sputtering times ranging from 2 to 15 s under exposure 70 ppm C_2H_5OH at optimal operating temperature of 350℃ in relative humidity of 30%. The corresponding changes in conductance are shown in the insets.

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