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Selective H_2S Gas Sensors Based on Au-functionalized WO_3 Nanowires

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Abstract:

Thermal oxidation is the one of techniques for synthesis of various one-dimensional metal oxide nanostructures which has been established by SENSOR laboratory [1-3]. Due to many advantages of this technique, including scalability for mass-production, capability to control the growth pattern with shadow masking technique and low cost method [1, 3], it is interesting to synthesize metal oxide nanowires by this method for gas sensing materials. In this present study, the fabricated sensor based on WO_3 nanowires sensing films were grown by thermal oxidation method on the alumina substrates in single step and then subsequently functionalized with gold nanoparticles as an excellent catalyst for gas-sensing reaction by RF magnetron sputtering with different sputtering time of 2, 5, 10 and 15 seconds. Structural characterizations of sensing films by electron microscopy and X-ray analysis revealed that WO_3 nanowires were highly crystalline with monoclinic structure and metallic Au-functionalized with crystalline WO_3 nanowires. The effect of Au sputtering time on gas sensing properties of WO_3 sensors were systematically tested towards H_2S, CO, NO_2 and acetone with different working temperatures ranging from 250-400ºC in dry air and humidity effects. It was found that an optimal Au sputtering time of 10 s led to significant enhancement of H_2S-sensing performances comparing with the other gases. Particularly, the optimal Au-functionalized WO_3 sensing film exhibited the highest response of 219 to 5 ppm H_2S at the optimal working temperature of 350°C with relative humidity of 50%. Therefore, the excellent Au-functionalized WO_3 nanowires are highly potential for selective H_2S detection.

Keywords: Tungsten oxide, Nanowires, Gas sensors, H_2S, Thermal oxidation.

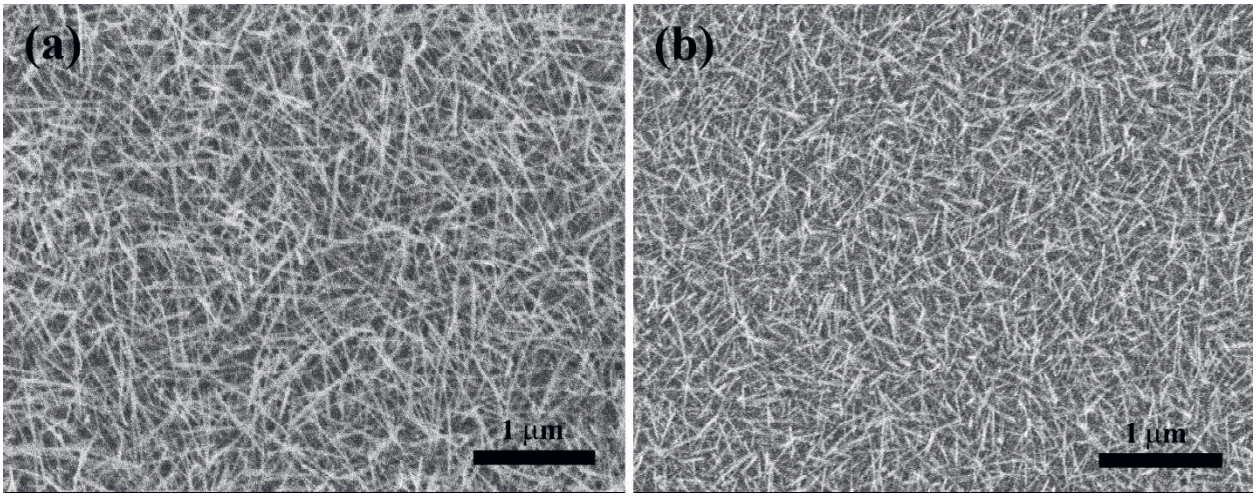

Fig.1. The typical SEM micrographs of (a) WO_3 nanowires and (b) WO_3 nanowires with Au sputtered at 10 s prapared by thermal oxidation method.

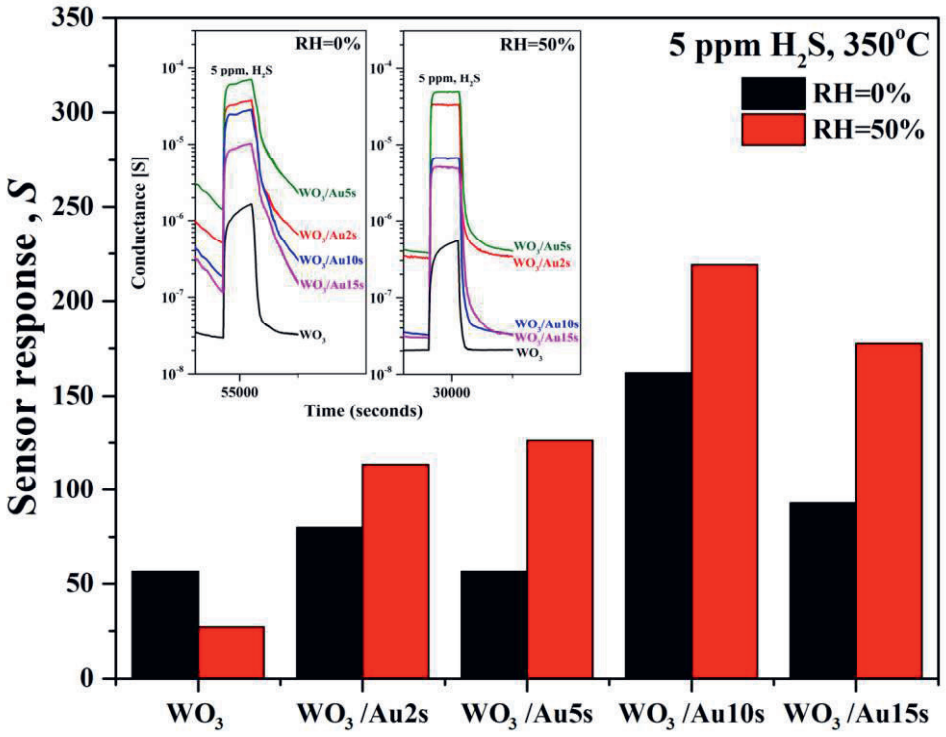

Fig.2. Gas-sensing properties of WO_3 and Au-sputtered WO_3 with sputtering times ranging from 2 to 15 s under exposure 5 ppm H_2S at optimal operating temperature of 350 °C in dry air and relative humidity of 50%. The corresponding changes in conductance are shown in the insets.

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