

## Preparation of SnO<sub>2</sub>-based gas sensor by Sol-Gel process

Kyungpook National University Anh-Hoa Bui, Won-Woo Baek, Sang-Tae Lee,  
Hee-Kwon Jun, Duk-Dong Lee, Jeung-Soo Huh

This paper presents the preparation of SnO<sub>2</sub> films by Sol Gel process and using spin coating method, and their sensing properties in CO gas.

Experimental procedure consisted of following steps: (1) Tin chloride (SnCl<sub>4</sub>) and Ammonium hydrogen carbonate (NH<sub>4</sub>HCO<sub>3</sub>) were used as precursors; (2) the Sol solution with concentration of about 10wt% SnO<sub>2</sub> was prepared from washed Gel-precipitate for spin coating step; (3) thereafter, the coating solution was dropped onto the alumina (Al<sub>2</sub>O<sub>3</sub>) substrate that was then spun, the spin coating was carried out with total 10 times; (4) finally, the films were calcined for 3 hours at 500°C or higher temperature (600, 700, 800 or 900 °C) in order to obtain various grain sizes. The average grain size was calculated by Scherrer's equation using main peaks in XRD spectra; meanwhile the thickness, microstructure and surface morphology of the films were observed by FE-SEM.

As can be seen from the cross-section picture, the thickness of the films was 1.5µm. All the XRD data showed that the crystalline structure of the films is cassiterite SnO<sub>2</sub>. Simultaneously, XRD analysis also indicated that the grain size of the films increased from 8.4nm to 28nm as calcination temperature increased from 500°C to 900°C. Obviously, when calcination temperature is lower, smaller grain size can be obtained. The calcination temperature has much influence on the grain size, surface morphology of the films. The FE-SEM pictures illustrated the cracks on the surface, and the cracks was larger when calcination temperature was higher. The films calcined at 600°C for 3 hours were used for evaluating sensing properties. The sensitivity was defined as  $S(\%) = \{(R_{air} - R_{gas}) / R_{air}\} \times 100$ ; here  $R_{air}$ ,  $R_{gas}$  is the SnO<sub>2</sub> film resistance in the air and in CO gas at the same temperature, respectively. The concentration of CO gas was controlled with values of 10, 50 and 100ppm when flow rate of synthesis air was changed with utilizing the MFC. The results showed that the nano-SnO<sub>2</sub> films prepared by the above process can be used to detect CO gas with high sensitivity. In addition, at higher operating temperature the SnO<sub>2</sub> films had a higher sensitivity.