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Extended Abstract

Morphological Control of Metal Oxide for Semiconductor-Based Gas Sensor †

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Morphological control of metal oxide (MO) is important for enhancement of sensing properties such as sensor response and response-recovery characteristics. Our research group has been developed MO based gas sensors fabricated by WO_3 and SnO_2 nanocrystals synthesized by hydrothermal method for high sensor response to NO_2 or H_2 [1,2]. On the other hand, shuttle-shape SnO_2 showed the sensor response to NO_2 and H_2S at room temperature.

The film sensor with cuboid-shape monoclinic WO_3 nanocrystal (Figure 1a) showed sensor response (Rg/Ra) of 10^2–10^4 to 0.05–1 ppm NO_2 at 200 °C (Figure 1c). In contrast, the sensor with hexagonal-shape hexagonal WO_3 nanocrystal (Figure 1b) showed sensor response lower one order of magnitude than that with cuboid-shape monoclinic WO_3 in above same detection condition (Figure 1d). This difference was related to surface states. XPS spectra of O1s showed that the content of OH^- was larger for hexagonal-shape hexagonal WO_3 ($O^{2-}/OH^-/H_2O$ (in %) = 60.0/38.1/1.9, in Figure 1e) than for cuboid-shape monoclinic WO_3 (80.4/4.9/14.7, in Figure 1f). The results suggested that the high content of oxygen adsorbate (O^{2-}) on the surface of WO_3 could be contributed to higher sensor response.

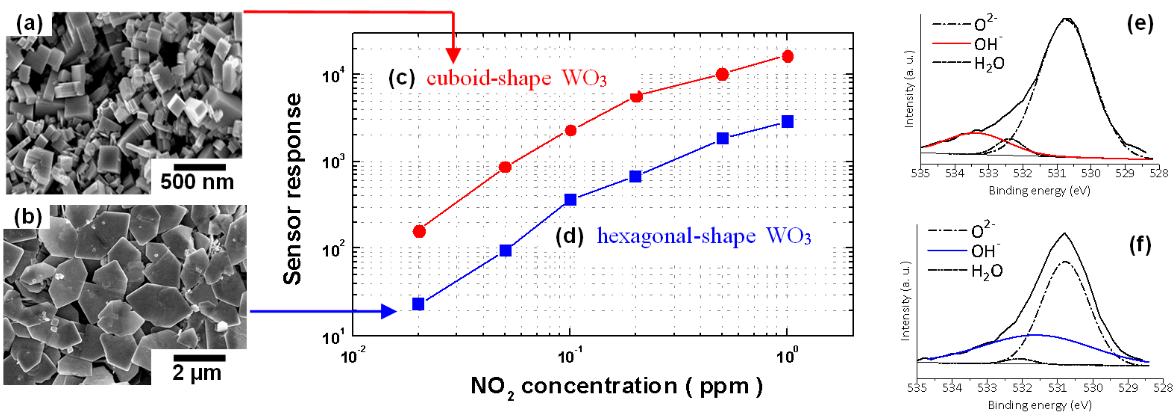

Figure 1. FE-SEM images of (**a**) cuboid-shape monoclinic WO_3 nanocrystal and (**b**) hexagonal-shape hexagonal WO_3 nanocrystal. Sensor response as a function of NO_2 concentration for (**c**) cuboid-shape WO_3 and (**d**) hexagonal-shape WO_3. XPS spectra of O 1s on the surface of (**e**) as-prepared cuboid-shape WO_3 and (**f**) hexagonal-shape WO_3.

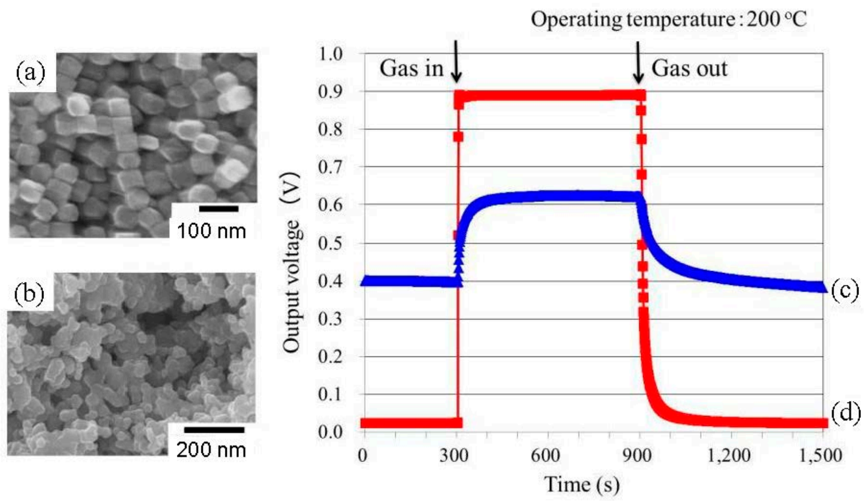

Figure 2. FE-SEM images of (**a**) SnO_2 nanocubes annealed at 250 °C for 3 h and (**b**) commercial SnO_2 nanoparticles calcined at 1100 °C. Response- recovery transients of (**c**) and (**d**) to respective gas mixture of 1000 ppm H_2 and air.

References

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