Effect of Gap Separation on Performance of Nanogap Electrode-based Oxygen Sensor

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Development of a simple, low-cost, and high-performance oxygen gas sensor is highly desired for many areas such as environment and transportation [1]. In this regard, nanogap electrode-based gas sensor is a promising candidate to become the next-generation device because of its high sensitivity, fast, low power consumption, and portability. Previously, we have developed robust Pt-based nanogap electrodes with 10 nm scale in the gap separation by electron beam lithography (EBL) [2], and demonstrated response improvement of nanogap electrode-based oxygen gas sensor as compared with the microgap counterpart [3]. In this study, we investigate the gap separation dependence and discuss the impact on oxygen sensing performance of nanogap gas sensor.

The top-contact type nanogap gas sensor was fabricated as follows. Firstly, CeO_2 film (~28 nm), as an oxygen sensitive material, was deposited on a SiO_2 (50 nm)/Si substrate by spin-coating method using cerium acetate as a raw material. After that, the Pt-based nanogap electrodes with various gap separations (L_G), ranged between 20 and 120 nm, were fabricated on the CeO_2 film by means of EBL [2]. Top-view structures of the nanogap gas sensors were observed by scanning electron microscope (SEM) as shown in Fig. 1. The responses of nanogap gas sensors to oxygen as a function of L_G were measured at 573 K. The result shows that both sensitivity and response time are improved with the reduction of L_G.

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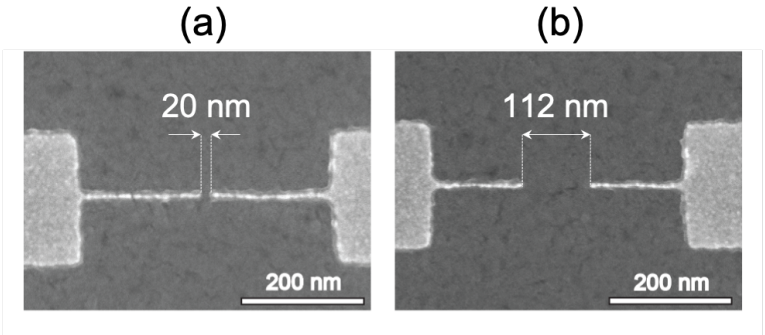

Fig. 1 SEM images of nanogap gas sensors with gap separation of (a) 20 nm and (b) 112 nm

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