Top- and Bottom-Contact CeO_2 Nanogap Gas Sensor

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The increasing demand of oxygen gas sensor in various fields such as environmental monitoring, food industry and medical care has urged the development of fast response, reliable, compact and inexpensive sensors. However, the conventional electrochemical-based oxygen gas sensors are relatively high cost and large in dimension, which hinder them from applications. Owing to the small size, low cost and the possibility of mass-production, resistive-type gas sensor based on metal-oxide semiconductor has become a promising candidate [1]. Previously, we have demonstrated the nanogap oxygen gas sensor using a combination of the robust and ultrafine Pt-based nanogap electrodes [2] and solution-processed cerium oxide (CeO_2), and achieved a fast response (~10 s) [3]. In this work, we demonstrate top-contact and bottom-contact types of nanogap gas sensors' responses.

Schematic diagrams of the two nanogap gas sensors are shown in Figure 1. The CeO_2 sensing layer with a thickness of 28 nm was prepared by spin-coating method. The Pt-based nanogap electrodes were fabricated by a combination of electron-beam lithography and electron-beam evaporation methods as previously reported in [2]. The electrode linewidth and gap separation are estimated as approximately 10 and 20 nm, respectively by SEM images. The sensor response was evaluated by measuring the change in sensor's conductance when the oxygen partial pressure was changed at an operating temperature of 300 ℃. We will discuss the difference in gas sensor performance between top- and bottom-contact nanogap gas sensors.

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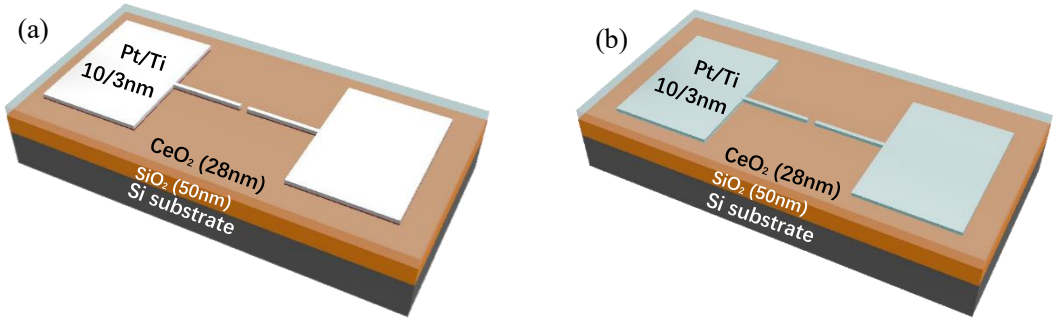

Figure 1. The schematic diagrams of nanogap oxygen gas sensors: (a) top-contact and (b) bottom-contact types.

References

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