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Effects of thickness and catalysis on SnO_{2-x} thin film gas sensor fabricated by ion assisted deposition

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SnO_{2-x} based gas sensing elements for the detection of inflammable gases of CH_4 and C_3H_8 were fabricated by an ion beam assisted deposition technique. Substrates of SiO_2 (ion sputtered with 3000Å)/Si-wafer and Al_2O_3 (10 mm×5 mm×0.4 mm) were employed on deposition. Structure of the sensor elements is as follows; Pd-Ag paste was screen printed on the back of the substrate as heater and SnO_{2-x} films with 300 ~ 2000Å thickness were deposited on the Al_2O_3 and SiO_2/Si substrates, then Pd activation layer (10Å) was surface adsorbed on the synthesized SnO_{2-x} films. Finally, a pattern of Pt electrode is deposited on the Pd/SnO_{2-x} thin film. In order to consider the annealing effect, the Pd/SnO_{2-x} thin films were heated at 300 ~ 600 ℃ for 2 hr in a conventional furnace.

Using the Pd/SnO_{2-x}/SiO_2/Si-wafer sensor, the sensitivities of the sensor was 90 ~ 93 % at 160℃ for 3000ppm C_3H_8., but its stability was found to be very poor. In the case of Pd/SnO_{2-x}/Al_2O_3 substrate sensor, the sensitivities also showed above 95 %. The stability of SnO_{2-x} film(1000Å) deposited on Al_2O_3 substrate showed improved stability as compared to SnO_{2-x} with 300Å. Also, the employment of Pd activation layer led to the reduction of sensor operating temperature below 150℃. In conclusion, the Pd/SnO_{2-x}/Al_2O_3 structure showed higher sensitivity for C_3H_8 than that of Pd/SnO_{2-x}/SiO_2/Si-wafer sensor. This could be understood by the fact that the large surface roughness of the Al_2O_3 substrate would provide pure active sites to C_3H_8. Moreover, the film thickness of SnO_{2-x} film for good stability with higher sensitivity was believed to be around 1000Å.