ROOM-TEMPERATURE GAS SENSING WITH A HYBRID POLY-SI/ZNO TFT CELL

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In this work, we study the capability of a novel poly-Si/Zno hybrid TFT cell in sensing NO_2 gas. Fabrication and structural features of this cell are identical to that reported in one of our previous works [1] except that the IGZO TFT is replaced by a ZnO one. The equivalent circuit of the hybrid cell is shown in Fig. 1, in which the poly-Si TFT and ZnO TFT are employed as the amplifier and sensor, respectively. In the configuration, the top gate of the poly-Si TFT is electrically connected to the drain of the bottom-gated ZnO TFT, while the top surface of the ZnO channel is exposed to the environment for sensing purposes. For the electrical measurements conducted at room temperature, the current source (I_{IN}) was set at 100 pA with a compliance V_G of 2 V. Concentration of the NO_2 gas in the ambient was varied from 0 ~100 ppm. Transfer characteristics of the cell are expressed by showing the drain current of the poly-Si TFT as a function of the back-gate bias (V_{BG}) of the ZnO TFT. In the figure, we can see the I-V curves show a parallel and positive shift as the concentration of the NO_2 gas is increased. Meanwhile, the transitions in the figure are steep with a slope of around -60 mV/dec whose absolute value is much smaller than the subthreshold slopes of the individual ZnO TFT (>300 mV/dec). The finding provides good evidence showing the potential of this scheme in promoting measurement sensitivity compared with conventional oxide-semiconductor TFTs. The experimental results also show that UV irradiation can recover the characteristics.

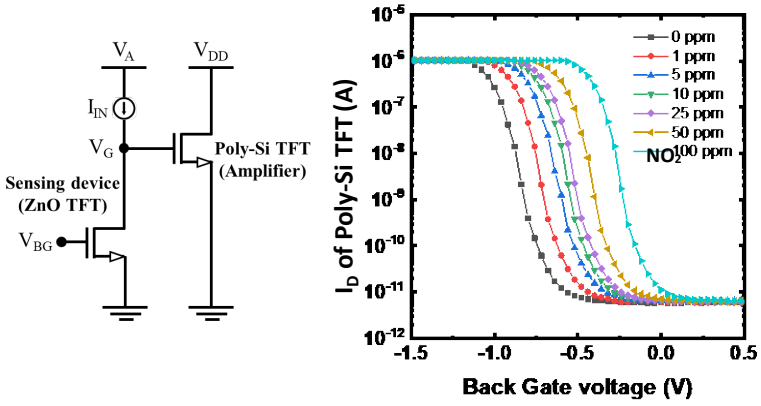

Figure 1 – Equivalent circuit of the poly-Si/ZnO TFT cell and the transfer characteristics of the cell measured in ambient with various NO_2 concentrations.

Reference

[1] P.-C. Liu, J.-C. Liao, C.-J. Su, P.-W. Li, and H.-C. Lin, "A novel poly-Si/IGZO thin-film transistor process platform for sensor applications," in 2022 International Conference on Solid State Devices and Materials, pp. 341-342, Sep. 2022