Supporting Information

To rule out the possibility that the SI signal and the reference current I_0 in synthetic air (SA) came from uncontrolled leakage current through the substrate, some experimental studies were performed. The experiments shown in this work have clearly revealed that the current across the gap between SnO_2 nanowire and Pt counter electrode is increased when the nanowire device is exposed to ionizable test gases. In addition to the gas-induced signal current, also a background current I_0 was observed, which is unrelated to the gas signal current but dependent on experimental parameters such as the device operating temperature and the bias potential at the counter electrode. To track down possible reasons for this background current, calibration prototypes were produced as shown in Fig.I. These were made up of two FIB-deposited Pt stripes positioned directly opposite to each other, separated by distances below one micron and an ion milled separation trench in between.

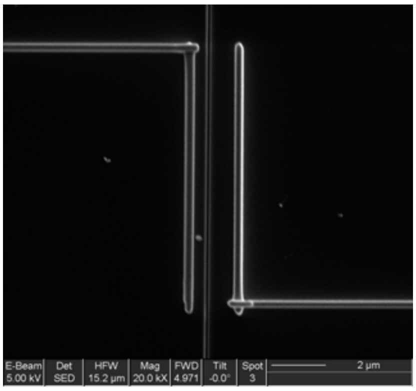

Figure I. Calibration device fabricated with FIB lithography. Two platinum strips are facing with a milled trench in between to avoid uncontrolled leakage current contributions.

In order to prevent parasitic electrical conduction through the Si substrates, the substrates were covered with a 50 nm-thick thermally grown SiO_2 layer prior to device processing. Later on, pre-patterned microelectrodes were fabricated on the oxidized surface using standard microelectronics techniques. In order to eliminate leakage currents between the two Pt stripes that might originate from the residual Pt halo that develops during the nanofabrication process[i]. When measured at room temperature (T=25°C) in dry synthetic air, these calibration prototypes exhibited resistance values higher than 0.5 TΩ (usually currents lower than 10 pA were measured at a bias voltage of 5V). Temperature-dependant measurements, carried out inside the FIB chamber under vacuum conditions (10^{-5} mbar), revealed that the background current I_0 increases as the temperature is increased. Current levels at 500°C, however, still stayed much lower than those background levels that were observed in our gas sensing tests. Considering an emitter temperature of 300°C, the background current in Fig.II is $I_0 \sim 5*10^{-2}$nA whereas $I_0 \sim$ 30nA when the device is operated in SA, i.e. under typical gas sensing conditions. Thus, the background current levels observed under typical gas sensing conditions are likely to be related to the gas ambient of the single-nanowire devices. The important thing to be borne in mind is that these latter currents form a constant background signal which is unrelated to the presence or absence of the test gases. Insofar the situation in a SI device is similar to the one observed in RES gas sensors where the background current in the metal oxide layer is due to electrons thermally generated in the subsurface bulk regions of the device being unrelated to the presence or absence of surface adsorbates.

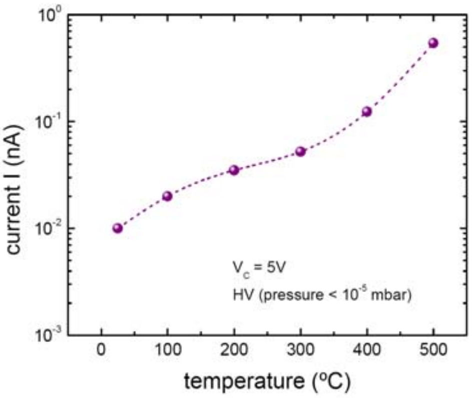

Figure II. (a) Reference current I_0 as function of temperature observed in UHV conditions. Bias voltage was kept constant at $V_c = 5$ V.

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[i] J. Mengailis, Focused ion beam technology and applications, J. Vac. Sci. Technol., B **5** (1987), pp. 469–495.