Supporting Information

Formaldehyde sensing mechanism of SnO_2 nanowires grown on chip by sputtering techniques

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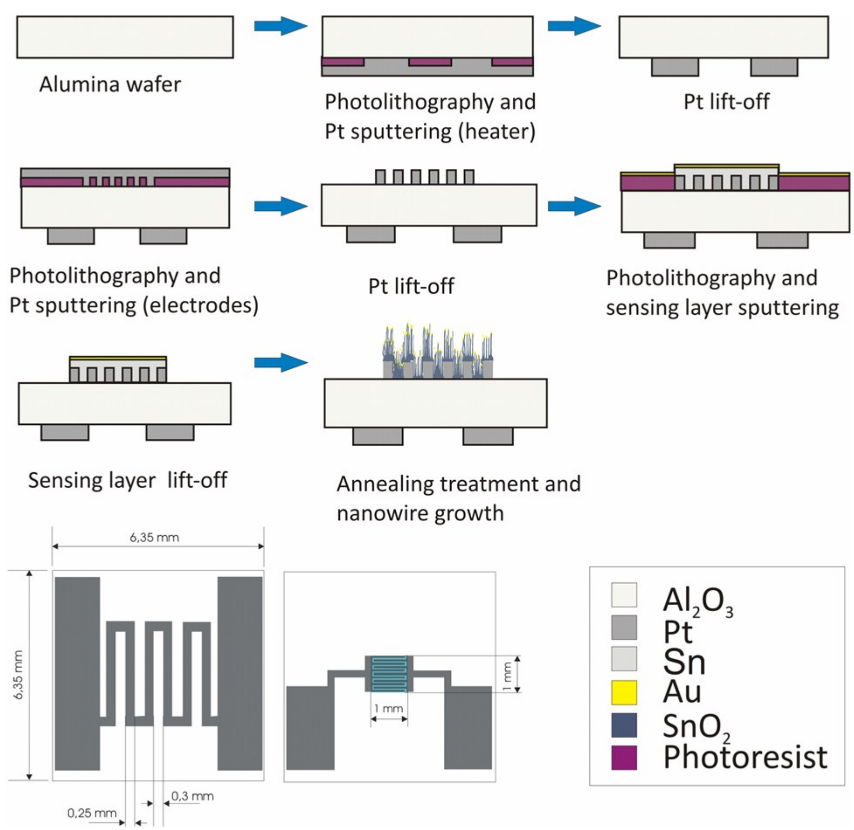
Supporting Information

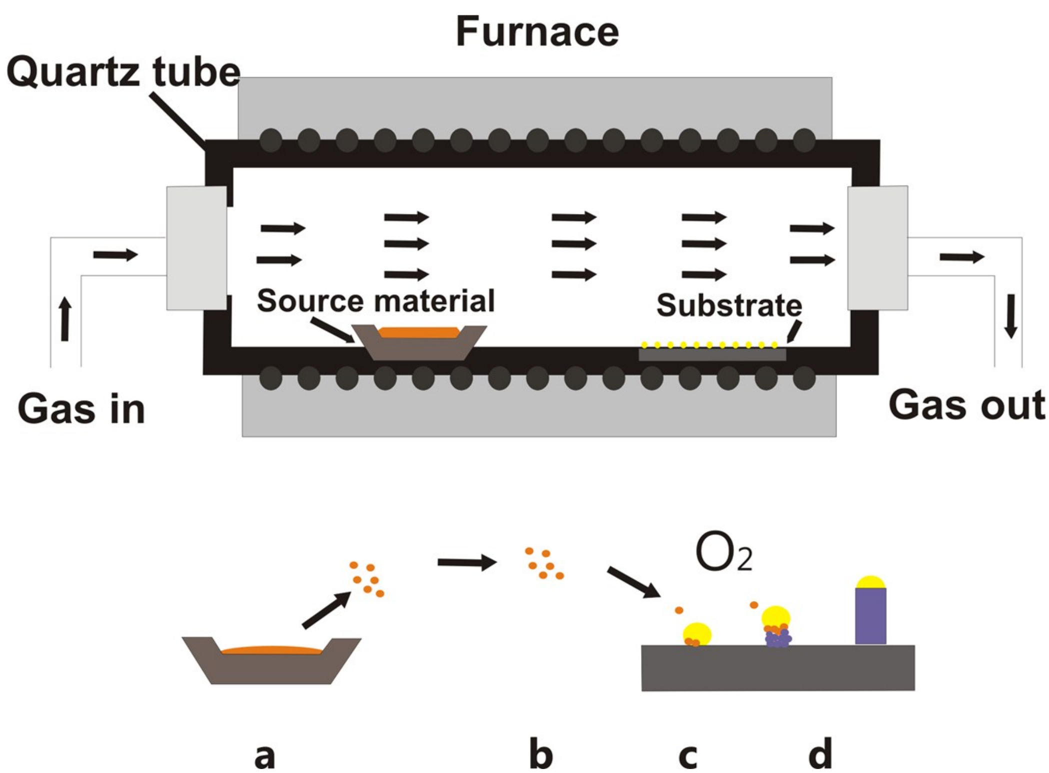
Figure S1

Gas sensors were fabricated on alumina substrates (thickness:0.254 mm) The sensing device was prepared following a 3-step photolithography and sputtering (Edwards coating system E306A) process: at first step, a Pt heater was deposited on the back side of the alumina substrate by DC sputtering. This element is used to heat the sensing material to the required operating temperature for gas detection. Then, Pt interdigitated microelectrodes with a finger width of 50 µm were deposited on the front side. The Pt sputtering process was carried out at $2x10^{-3}$ mbar for a deposition time of 30 minutes giving a thickness of 200 nm. In the third step, the sensing layer (area: 1x1 mm^2) was deposited over the Pt microelectrodes using a Sn (99.99%) and Au (99.99%) targets. In brief, a 1 µm-thick Sn film was deposited by DC sputtering for a deposition time of 20 minutes and afterwards, an Au thin film (5 nm) was deposited by RF sputtering; RF power was maintained at 25 W for 1 minute. Finally, an annealing treatment was carried out in a PEO 601 ATV furnace with a constant flow of 400 sccm to grow the nanowires in-situ over the electrodes. A scheme of the fabrication process is shown in Figure S1 (Supporting Information).



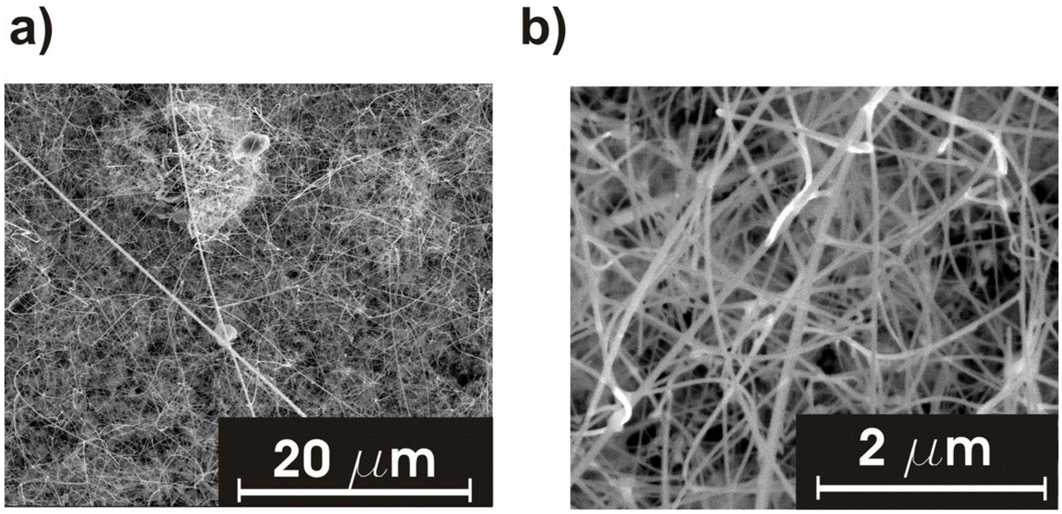
Supporting Information

Figure S2: Scheme of the fabrication process of NWs by VLS mechanism employing CVD techniques. a) evaporation of Sn powder, b) transport to nucleation point, c) Sn atoms stuck to Au nanoparticle, d) oxidation and solidification.

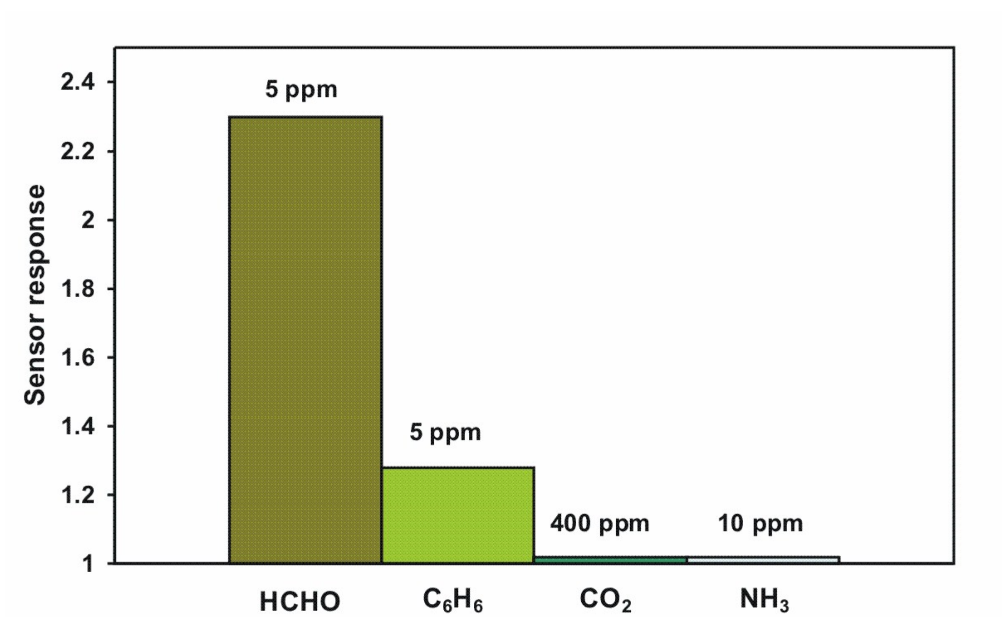


Supporting Information

Figure S3: SEM micrographs of the nanowires grown in-situ over electrodes, showing a good and uniform coverage. a) Samples viewed at a 20µm scale and b) 2µm scale.

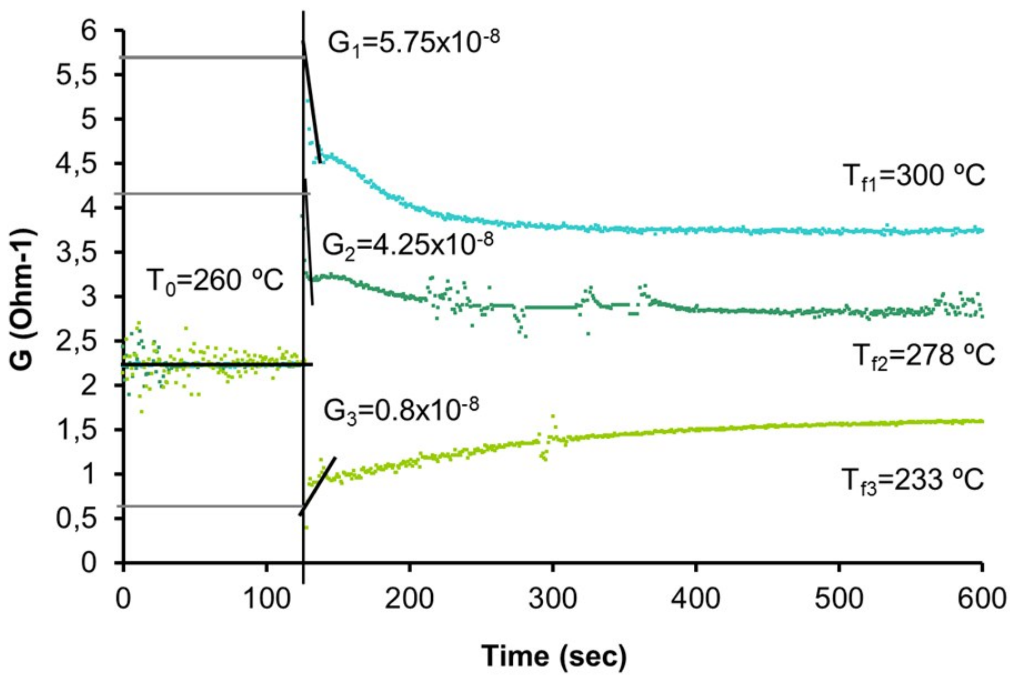


- **Figure S4**: Selectivity measurements of the in-situ grown SnO_2 NWs gas sensors against HCHO, C_6H_6, CO_2 and NH_3.



Supporting Information

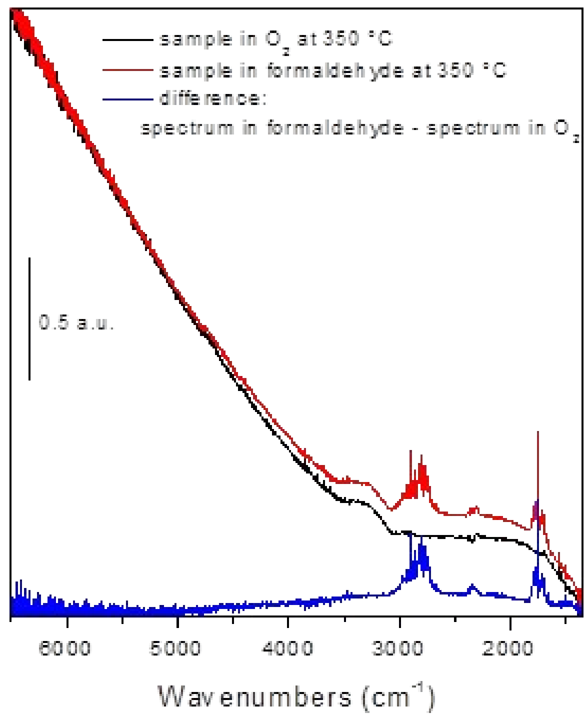
- **Figure S5**: Conductance transient response in air under fast temperature change. Starting temperature (260 ºC) is changed abruptly to three different temperatures (233, 280 and 300 ºC). This method, explained in detail in the work from Carotta el at, consists in evaluating the conductance transient response under a fast temperature change. Assuming that the potential energy barrier changes more slowly than the temperature of the sensor and free carrier concentration, the extrapolation of the curves to zero time gives the value of conductance when the sensor has the initial barrier but a changed temperature. From this analysis it is possible to estimate the constant G_0 and the barrier energy at different temperatures.



$$G = G_0 \exp\left(-\frac{eV_s(T)}{k_B T}\right)$$

Supporting Information

- **Figure S6**: FT-IR spectrum in oxygen (black line in figure) and the spectru in formaldehyde (red line) recorded at 350 °C. The blue line in the figure below is the difference spectrum reported in the manuscript.



Supporting Information

- **Figure S7**: I-V curves of samples measured with a 2450 Keithley Sourcemeter in a two probe mode at a voltage range of -5 to +5 V and temperatures between 200 and 300 ºC.