chemosensors

Supplementary Information

Flexible Impedimetric Electronic Nose for High-Accurate Determination of Individual Volatile Organic Compounds by Tuning the Graphene Sensitive Properties

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The result of dynamic impedance (f = 100 kHz) measurement is shown in Figure S1. The sensor (rGO, 200, 2 L) was alternatively placed into a reference bottle (0 ppm, only di-water) and VOC bottles (10–80 ppm methanol, a mixture of VOC liquid and di-water). The sensor's relative impedance change significantly increases when moving into VOC bottles, and can also recover to the initial value (Z_0) if put back into the reference bottle. Furthermore, the relative changes are totally different under different concentrations of methanol bottles.

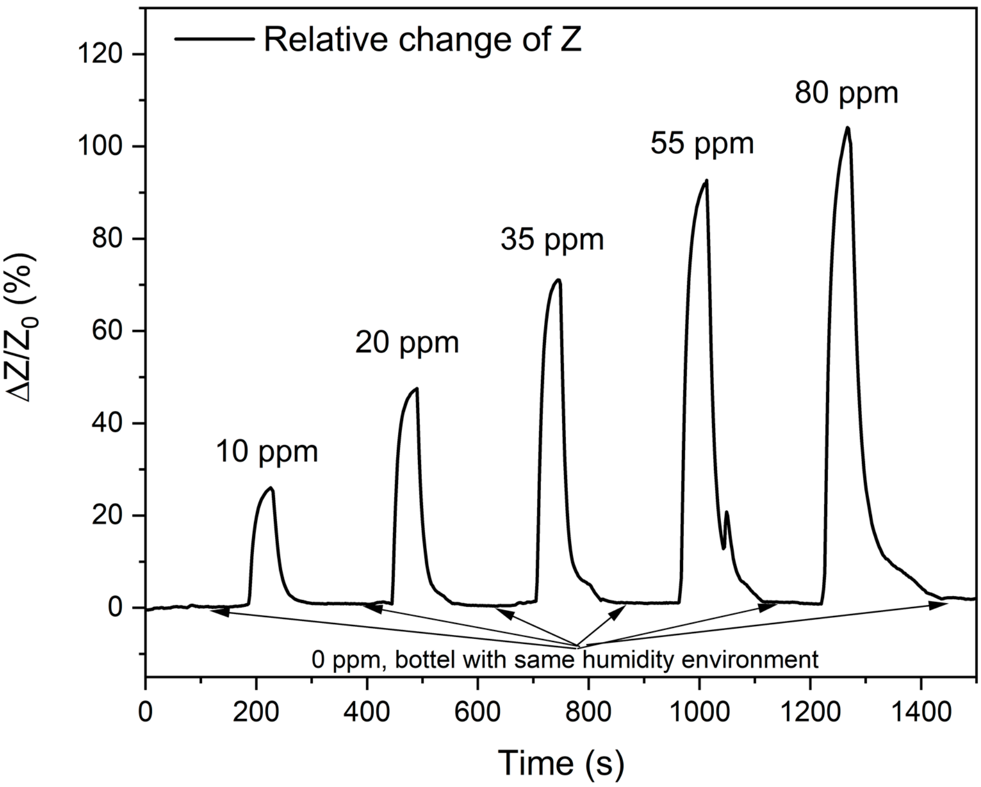

Figure S1. The dynamic impedance response of the rGO sensor in reference and VOC bottles alternatively.

The proposed sensor (rGO, 200, 2 L) was measured under pure N_2 flow (0 ppm) and N_2 flow with 80 ppm methanol alternatively. The VOC supply system is based on a low concentration VOC generator (GEN-SYS, Olwstone Ltd.) and gas mass flow control system. The resistance (DC) and impedance (AC, 100 kHz) measurements were executed by Keysight DAQ973A Data Acquisition System and HP 4284A LCR Meter, respectively. The $\Delta R/R_0$ still increases continuously after 60 s under flow with 80 ppm methanol, while the $\Delta Z/Z_0$ already becomes stable. Also, the $\Delta R/R_0$ cannot recover as low as $\Delta Z/Z_0$ after 60 s under flow with 0 ppm. It means that the proposed sensor shows faster response and recovery speed under proposed impedance condition (100 kHz) than under DC condition.

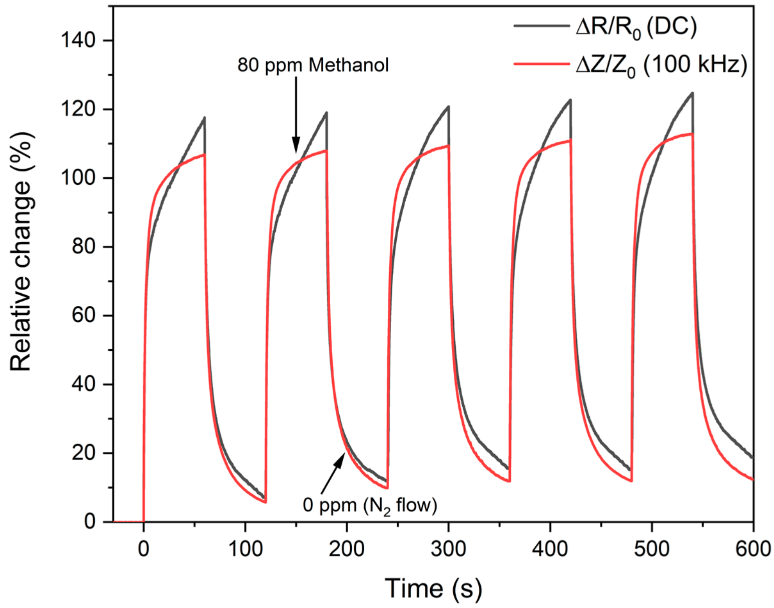

Figure S2. The dynamic response of the rGO sensor under DC and AC measurement conditions.

The real RH value in the VOC bottle is monitored using commercial calibrated humidity sensor SHT85 (see Figure S3). The calibrated sensor was moved from room environment to inside the bottle (headspace), then moved out back to room environment. The real RH value obtained in bottle is stable at around 90%.

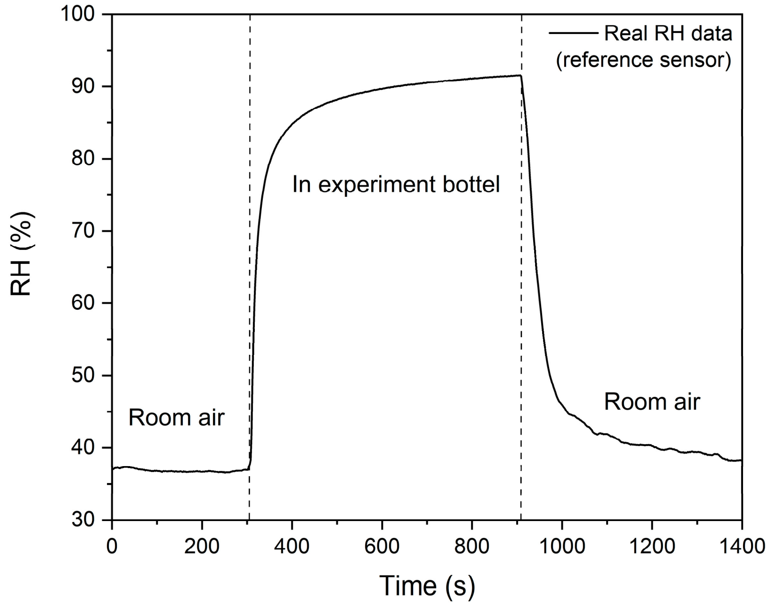

Figure S3. The real RH of VOC bottle measured by commercial reference sensor SHT85.

A humidity PID control system (LabView) and mass follow controllers were used to provide an air flow with RH 90%, to test the influence of RH on the relative impedance change of sensor (rGO, 200, 2 L). In Figure S4, an air flow with RH 90% can only cause an impedance change of around 1.4%, which is a tiny influence, especially compare to its VOC response (min. 28% to 10 ppm methanol; max. 257.93% to 80 ppm ethanol).

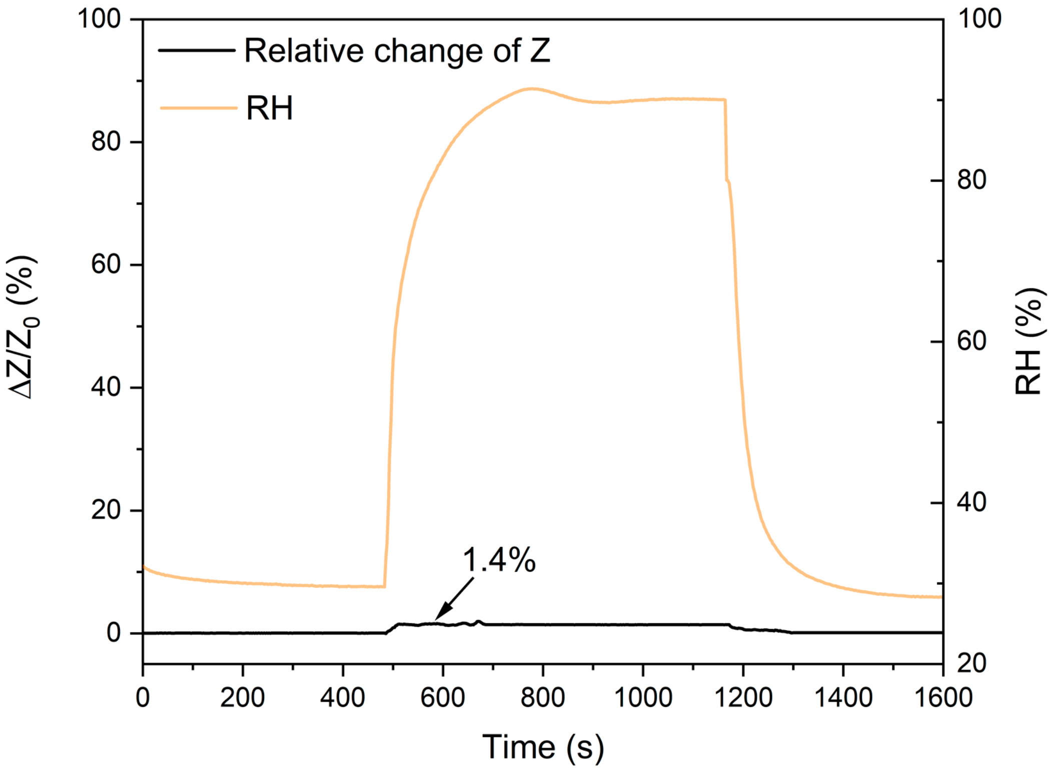

Figure S4. The influence of RH 90% on the relative impedance change of rGO sensor.