

Electronic Supplementary Information

A Noble Gas Sensor Platform: Linear Dense Assemblies of Single-wall Carbon Nanotubes (LACNTs) in a Multi-layered Ceramic/Metal Electrode System (MLES)

Tae-Yeon Hwang^{a†}, Yo-min Choi^{b†}, YoSeb Song^a, Nu Si A Eom^a, Seil Kim^a, Hong-Baek Cho^a,
Nosang V. Myung^{c,*}, Yong-Ho Choa^{a,*}

^a Department of Fusion Chemical Engineering, Hanyang University, Ansan 426-791, Republic of Korea

^b Material Technology Center, Korea Testing Laboratory, Ansan 426-910, Republic of Korea

^c Department of Chemical and Environmental Engineering, University of California, Riverside, CA 92521, USA

* Corresponding authors.

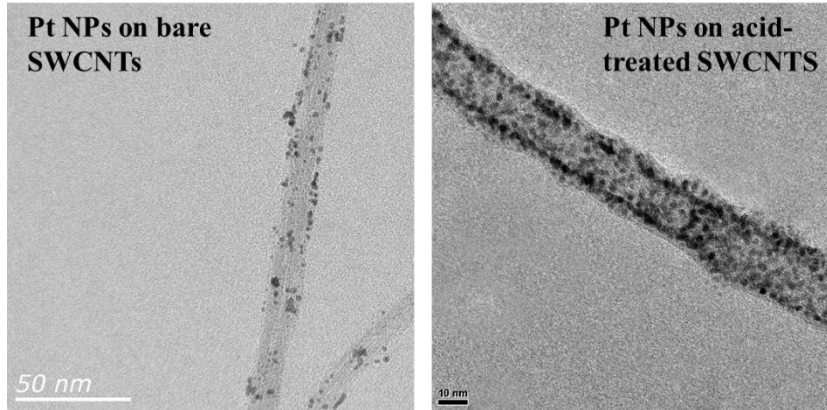
Tel.: +82-31-400-5650; Fax: +82-31-400-8128; *E-mail address*: choa15@hanyang.ac.kr (Y.-H. Choa)

Tel.: +1-951-927-7710; Fax: +1-951-827-5695; *E-mail address*: myung@engr.ucr.edu (N. V. Myung)

† These authors contributed equally to this work.

Calculation method of Pt nano crystals on SWCNTs.

- To quantify the amount of Pt nano crystals (NCs) decorated on bare and acid-treatment SWCNTs, we used the low magnification TEM images as shown below.



[low magnification image of Fig. 7 (b), (c) in the manuscript]

- At first, we measured the size of Pt NCs in each images. The mean size of Pt NPs on bare SWCNTs (b-SWCNTs) was 2.67 nm and Pt NPs on acid-treated SWCNTs (a-SWCNTs) was 2.1 nm. Next, we calculated the number of particles per 140 nm of SWCNTs and the results was 56 for b-SWCNTs and 164 for a-SWCNTs. Then, we calculated the volume of the Pt NPs and changed them to mass multiplied by density. Finally, we got the mass per nm of SWCNT ($\text{g/nm}_{\text{SWCNT}}$). The amount of deposited Pt NCs was decreased from $1.14 \times 10^{-18} \text{ g/nm}_{\text{SWCNT}}$ for Pt NCs on acid-modified SWCNTs to $7.99 \times 10^{-19} \text{ g/nm}_{\text{SWCNT}}$ for pristine SWCNTs.

Figures

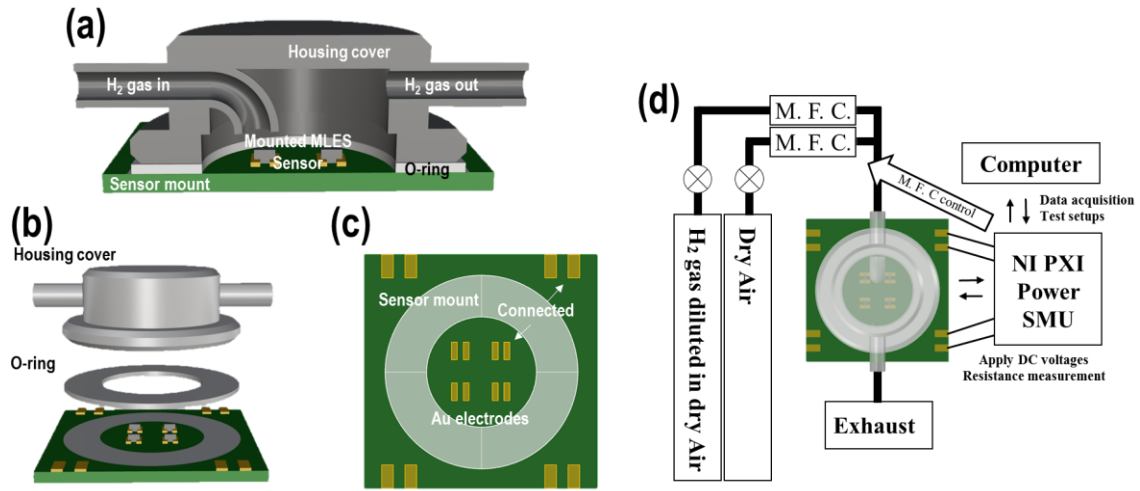


Fig. S1 Setups of the gas sensing chamber: (a) assembled chamber, (b) assembling components, (c) mounting board, and (d) overall test systems.

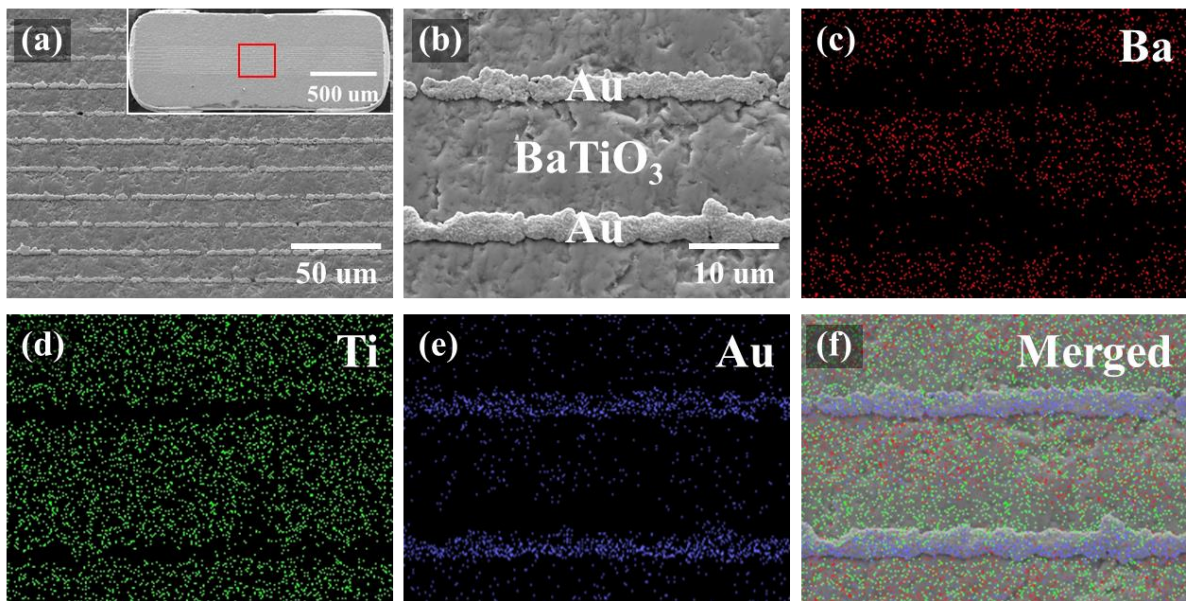


Fig. S2 FE_SEM images of (a) Au electrodes in MLES, (b) magnified surface of MLES, and (c – f) EDS mapping results of the surface.

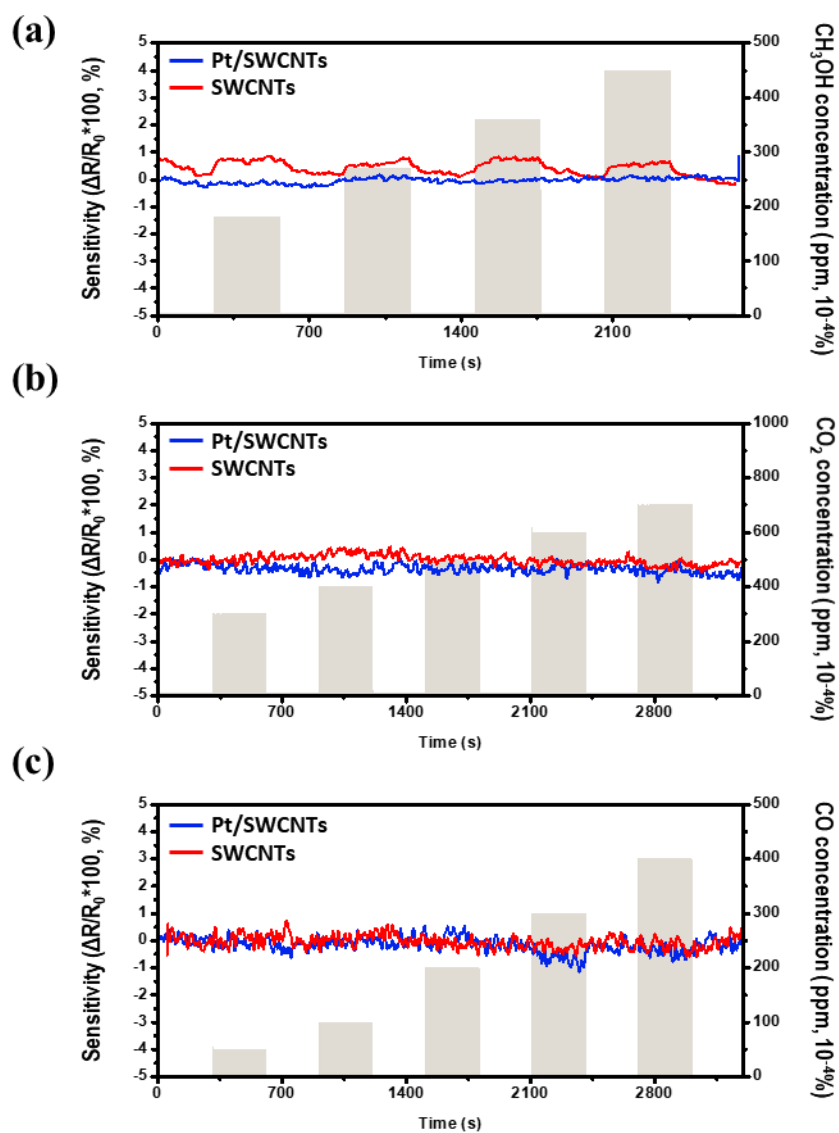


Fig. S3 Time dependent response of the electrical resistance change of the MLES-based Pt/SWCNTs and SWCNTs gas sensors as a function of the CH₃OH, CO₂ and CO concentrations at room temperature.

Table

Table S1. The sensitivity, response time (T_{90}) and recovery time (D_{50}) of the sensors for H_2 , H_2S , NO_2 and NH_3 gases at each concentrations.

Gas concentration	Sensitivity (%)		Response time (T_{90} , Sec.)		Recovery time (D_{50} , Sec.)	
	Pt/SWCNTs	SWCNTs	Pt/SWCNTs	SWCNTs	Pt/SWCNTs	SWCNTs
H_2 50 ppm	0.44	0.03	109.08	-	24.65	-
H_2 100 ppm	0.50	0.01	92.93	-	14.92	-
H_2 500 ppm	1.25	0.05	141.99	-	13.03	-
H_2 1000 ppm	2.01	0.11	105.21	-	11.51	-
H_2 3000 ppm	5.22	0.19	145.61	-	9.46	-
H_2S 5 ppm	1.98	0.76	210.91	225.65	160.65	-
H_2S 10 ppm	3.15	1.17	212.43	260.78	188.95	-
H_2S 20 ppm	4.53	1.82	252.57	265.71	194.40	-
H_2S 40 ppm	5.94	2.73	193.39	253.61	180.96	-
H_2S 60 ppm	7.43	3.60	195.56	244.30	179.39	-
H_2S 100 ppm	8.24	4.63	183.16	285.28	160.79	-
NO_2 5 ppm	-9.87	-3.94	182.75	224.73	203.20	-
NO_2 10ppm	-14.87	-8.06	191.30	250.17	104.95	-
NO_2 30 ppm	-22.61	-16.30	170.39	224.57	111.81	-
NO_2 50 ppm	-27.73	-21.58	170.06	213.78	264.33	-
NH_3 10 ppm	2.37	2.26	188.91	274.34	57.63	29.66
NH_3 30 ppm	4.72	3.82	215.12	172.91	51.68	16.60
NH_3 50 ppm	5.28	4.26	73.23	42.88	24.64	121.25
NH_3 70 ppm	8.09	6.24	208.26	158.04	13.05	17.61