Supporting Information

Design of Array Structure for Carbon-based Field-Effect-Transistor Type Gas Sensor to Accurately Identify Trace Gas Species

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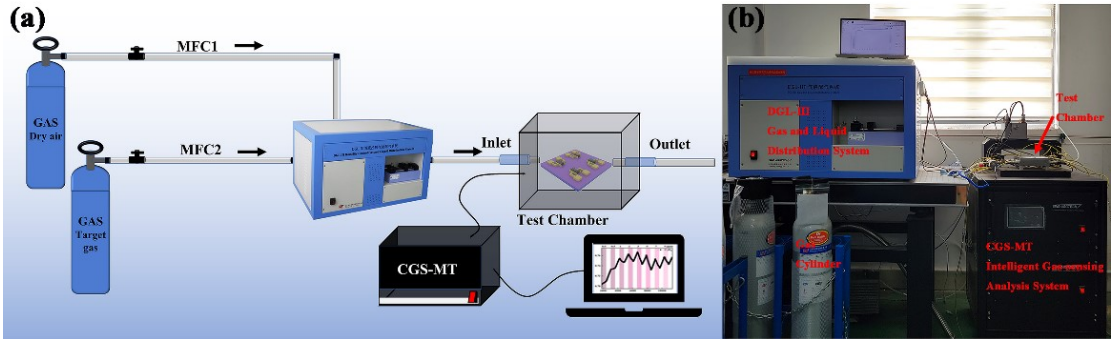

Fig. S1 (a) Schematic diagram of the gas sensing test system. (b) Digital photo of the gas sensing test

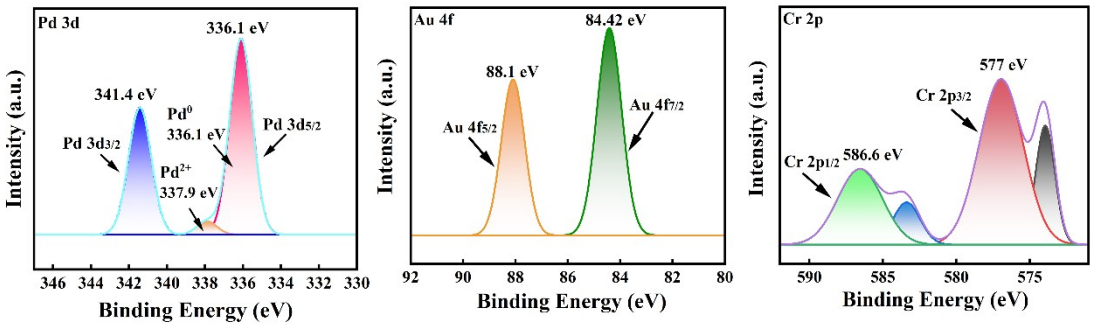

Fig. S2 The high-resolution XPS spectra of (f)Pd 3d, (g)Au 4f and(h) Cr 2p, respectively.

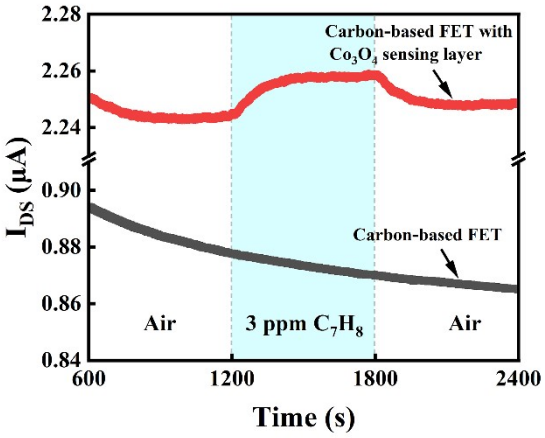

Fig. S3 Response/recovery curves of the carbon-based FET with and without Co_3O_4 sensing layer at 3 ppm C_7H_8, respectively.

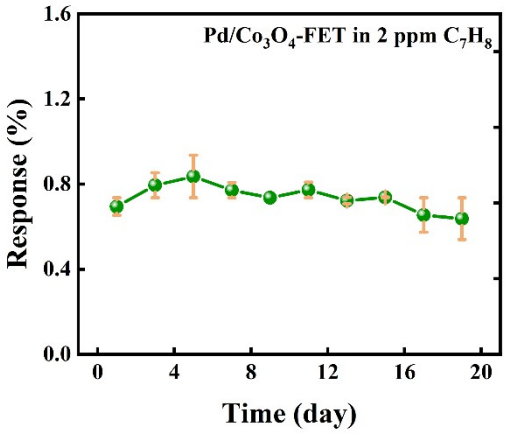

Fig. S4 Response values of the Pd/Co_3O_4-FET at 2 ppm C_7H_8 for up to 20 days.

Table S1 Comparison of the key features of the Pd/Co_3O_4-FET and various previously reported toluene gas sensors.

Sensing material	Sensor type	Operating temperature	Gas concentration	Advantages	Reference
Pd-Loaded SnO_2	Resistive	350℃	1 ppm	High selectivity for p-methylbenzene	[1]
Co_3O_4, Pd-Loaded Co_3O_4	Resistive	250-350℃	5 ppm	Highly selective, sensitive, and reliable manner	[2]
Cr_2O_3	Resistive	170℃	1 ppm	Simple preparation	[3]
Pd-loaded quintuple-shelled Co_3O_4	Resistive	250℃	0.25-5 ppm	Ultrahigh response, ultrahigh selectivity	[4]
$NiO/NiMoO_4$	Resistive	325-425℃	0.25 ppm	High selectivity and response	[5]
Pd/Co_3O_4	Floating-gate FET	Room temperature	80 ppb	Low power consumption, low detection limit, integrability, mass preparation	

Table S2 Comparison of response values (%) of the four gas sensing units to five gases at 3 ppm

	Gas sensing unit			
	Co_3O_4-FET	Pd/Co_3O_4-FET	Au/Co_3O_4-FET	Cr/Co_3O_4-FET
Response value ordering	$R_{C_6H_6} > R_{HCHO} > R_{NH_3} > R_{NO_2} > R_{C_7H_8}$	$R_{C_6H_6} > R_{HCHO} > R_{NH_3} > R_{C_7H_8} > R_{NO_2}$	$R_{NO_2} > R_{HCHO} > R_{C_7H_8} > R_{NH_3} > R_{C_6H_6}$	$R_{HCHO} > R_{C_7H_8} > R_{C_6H_6} > R_{NH_3} > R_{NO_2}$

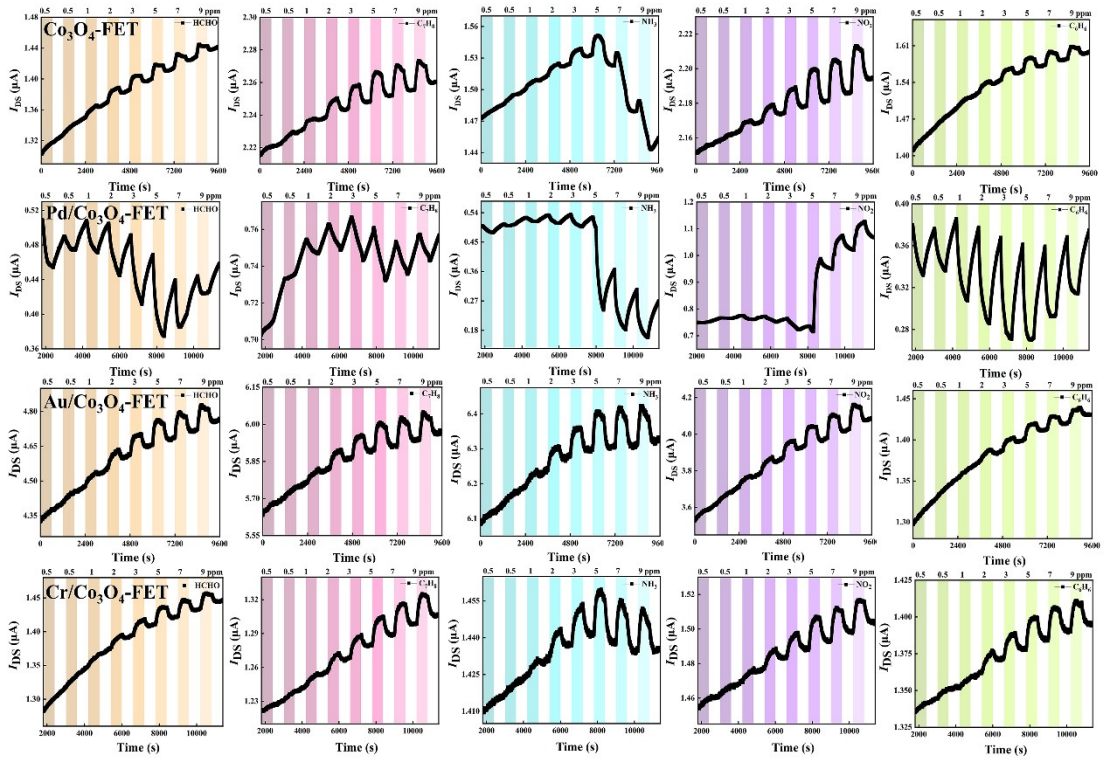

Fig. S5 Dynamic response/recovery curves of Co_3O_4-FET, Pd/ Co_3O_4-FET, Pd/ Co_3O_4-FET and Cr/ Co_3O_4-FET to HCHO, C_7H_8, NH_3, NO_2 and C_6H_6 at the range of 0.5-9 ppm, respectively.

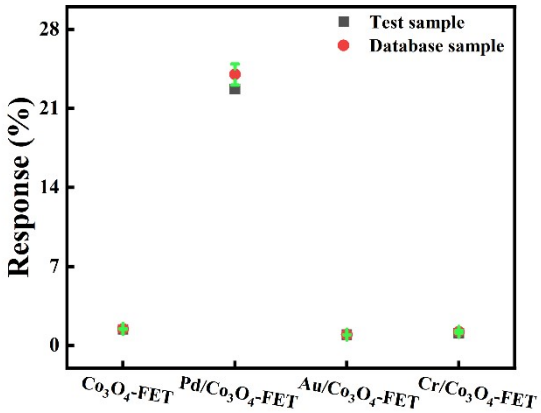

Fig. S6 Comparison of the response values of the carbon-based FET gas sensor array to the test sample and the database sample.