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## **Electronic Supplementary Information**

## All-Covalently-Implanted FETs with Ultrahigh Solvent Resistibility and Exceptional

## Electrical Stability, and Their Applications for Liver Cancer Biomarkers Detection

Congcong Zhang,<sup>‡ab</sup> Shanshan Cheng,<sup>‡\*a</sup> Ke Si,<sup>‡a</sup> Nannan Wang,<sup>‡cd</sup> Yong Wang,<sup>a</sup> Penglei

Chen,\*cde Huanli Dong,cd and Wenping Hu\*a

<sup>a</sup> Department of Chemistry, Tianjin Key Laboratory of Molecular Optoelectronic Sciences, School of Science,

Tianjin University, Tianjin 300072, China. E-mail: chengss@tju.edu.cn; huwp@tju.edu.cn

<sup>b</sup> Institute for Advanced Interdisciplinary Research, University of Jinan, Jinan 250011, China.

<sup>c</sup> Beijing National Laboratory for Molecular Science, CAS Key Lab of Colloid, Interface and Chemical

Thermodynamics, CAS Research/Education Center for Excellence in Molecular Sciences, Institute of

Chemistry, Chinese Academy of Sciences, Beijing 100190, China. E-mail: chenpl@iccas.ac.cn

<sup>d</sup> School of Chemical Sciences, University of Chinese Academy of Sciences, Beijing 100049, China.

<sup>e</sup> College of Chemistry and Molecular Engineering, Zhengzhou University, Zhengzhou 450001, China.

*‡* These authors contributed equally to this work.



**Fig. S1** Spectral characterization and ultrahigh solvent resistibility. (a-c) The typical UV-Vis spectra of our covalently-implanted 5-bilayered original GO (a), LRE-RGO (b), and HRE-RGO (c) films during ultrasonication treatments in ten kinds of common solvents for respective 100 minutes in succession (1000 minutes, totally).



**Fig. S2** Spectral characterization. (a-c) The C1s XPS spectra of our covalently-rooted original GO (a), LRE-RGO (b), and HRE-RGO (c) films.



**Fig. S3** Morphological characterization. (a-e) The typical AFM images of the original GO LBL films of different GO/APTMS bilayers. The number of the GO/APTMS bilayers in each case is indicated in the corresponding panels. The cross-sectional profile of the respective image is presented below the corresponding panels.



**Fig. S4** Morphological characterization. (a-e) The typical AFM images of the LRE-RGO films of different LRE-RGO/APTMS bilayers. The number of the LRE-RGO/APTMS bilayers in each case is indicated in the corresponding panels. The cross-sectional profile of the respective image is presented below the corresponding panels.



**Fig. S5** Morphological characterization. (a-e) The typical AFM images of the HRE-RGO films of different HRE-RGO/APTMS bilayers. The number of the HRE-RGO/APTMS bilayers in each case is indicated in the corresponding panels. The cross-sectional profile of the respective image is presented below the corresponding panels.



**Fig. S6** Electrical characteristics. The current-voltage (I-V) curves between the HRE-RGO source/drain electrodes and the LRE-RGO semiconductor layers of our all all-covalent FETs.



**Fig. S7** Sensing behaviors of our antibody-modified all-covalent FETs towards PBS. Practically, the standard deviation errors shown in Figure 6e of the main context are derived from the sensing behaviors of 100 individual antibody-modified all-covalent devices. (a-j) The 10 representative examples of the typical transfer characteristics of the antibody-modified all-covalent FETs before (black curve) and after (red curve) adding PBS.



**Fig. S8** Sensing behaviors of our antibody-modified all-covalent FETs towards AFP. Practically, the standard deviation errors shown in Figure 6e of the main context are derived from the sensing behaviors of 100 individual antibody-modified all-covalent devices. (a-j) The 10 representative examples of the typical transfer characteristics of the antibody-modified all-covalent FETs before (black curve) and after (red curve) adding AFP.



**Fig. S9** Sensing behaviors of our antibody-modified all-covalent FETs towards HSA. Practically, the standard deviation errors shown in Figure 6e of the main context are derived from the sensing behaviors of 100 individual antibody-modified all-covalent devices. (a-j) The 10 representative examples of the typical transfer characteristics of the antibody-modified all-covalent FETs before (black curve) and after (red curve) adding HSA.

Source/Channel/Source	Dielectric	Gate	Mobility (hole/electron)	References
RGO/RGO/RGO	SiO <sub>2</sub>	Si	$5.3  imes 10^{-2}$ /-	S1
RGO/RGO/RGO	PMMA	RGO	0.27/-	S2
BSRGO/BSRGO/BSRGO	SiO <sub>2</sub>	Si	365/281	S3
CVDG/CVDG/CVDG	Ion gel	PEDOT:PSS	214/106	S4
Graphite/CVDG/Graphite	SiO <sub>2</sub>	Graphite or Si	1800/1400	S5
CVDG/CVDG/CVDG	Ion gel	PEDOT:PSS	1188/422	S6
CVDG/CVDG/CVDG	GO	VCDG	300/250	S7
CVDG/CVDG/CVDG	Ion gel	VCDG	892/628	S8
RGO/RGO/RGO	SiO <sub>2</sub>	Si	0.33/0.37	This work

**Table S1** Charge mobilities of the graphene-based FETs reported by others and those of the present work.

## **Supplementary Notes and References**

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