Supporting Information

Ultrasensitive Label-Free MiRNA Sensing Based on Flexible Graphene Field-Effect Transistor Without Functionalization

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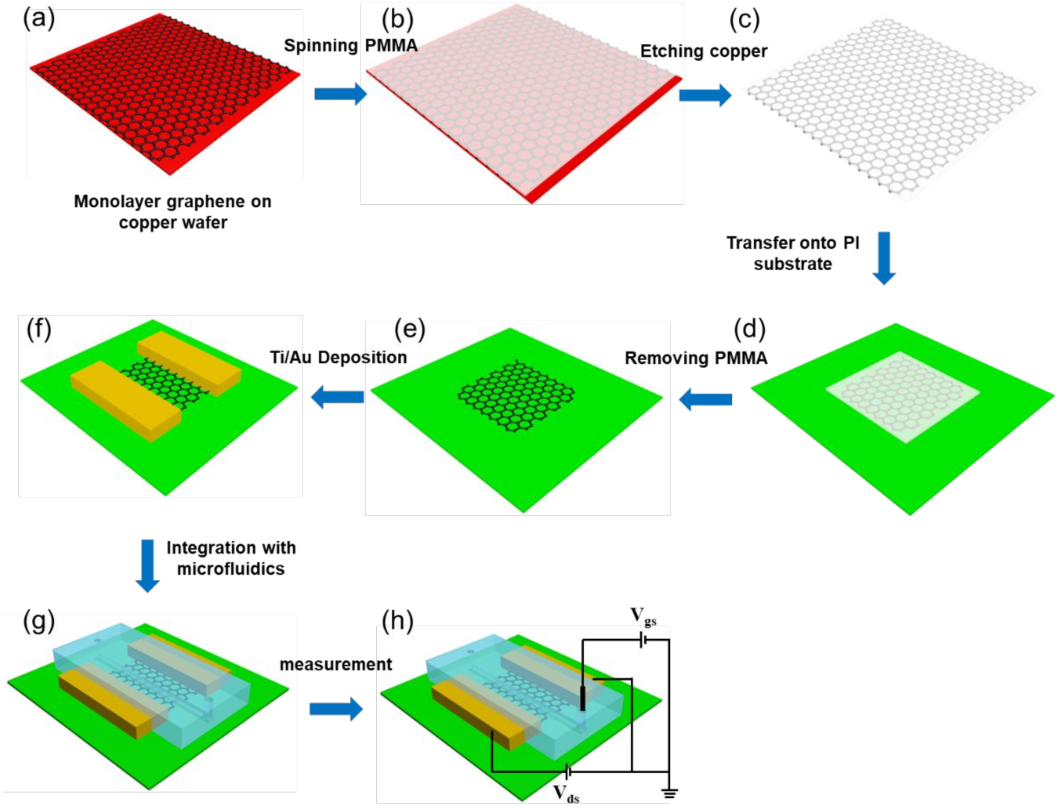

Figure S1. Fabrication process of graphene-field effect transistor biosensor.

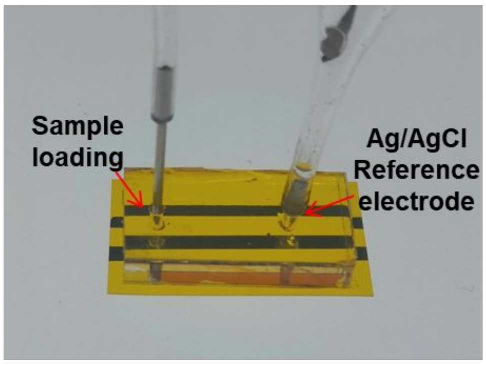

Figure S2. A photo of graphene transistor biosensor on PI substrate integrated with microfluidic.

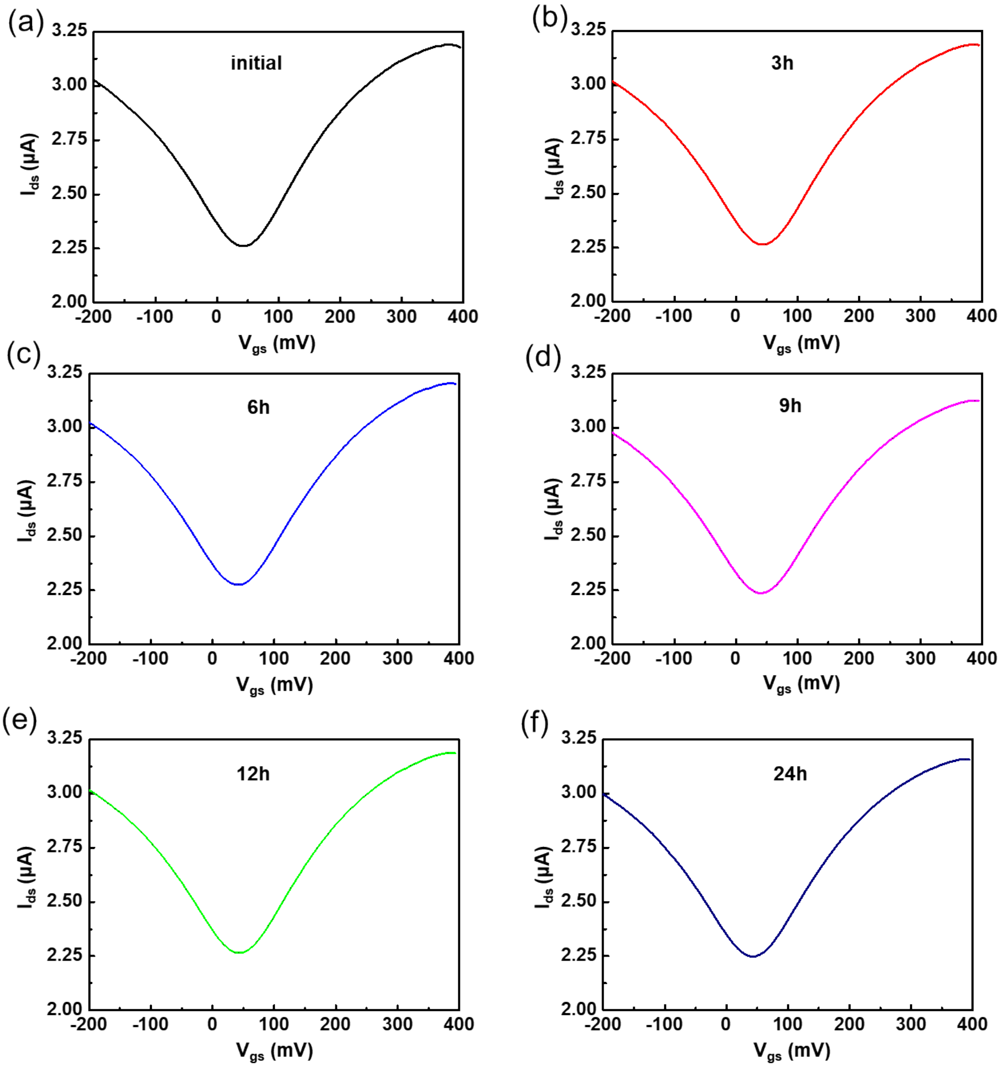

Figure S3. Transfer characteristics of a Gr-FET measured in PBS at (a) 0, (b) 3 hour, (c) 6 hour, (d) 9 hour, (e) 12 hour, (f) 24 hour, V_{ds} = 50 mV.

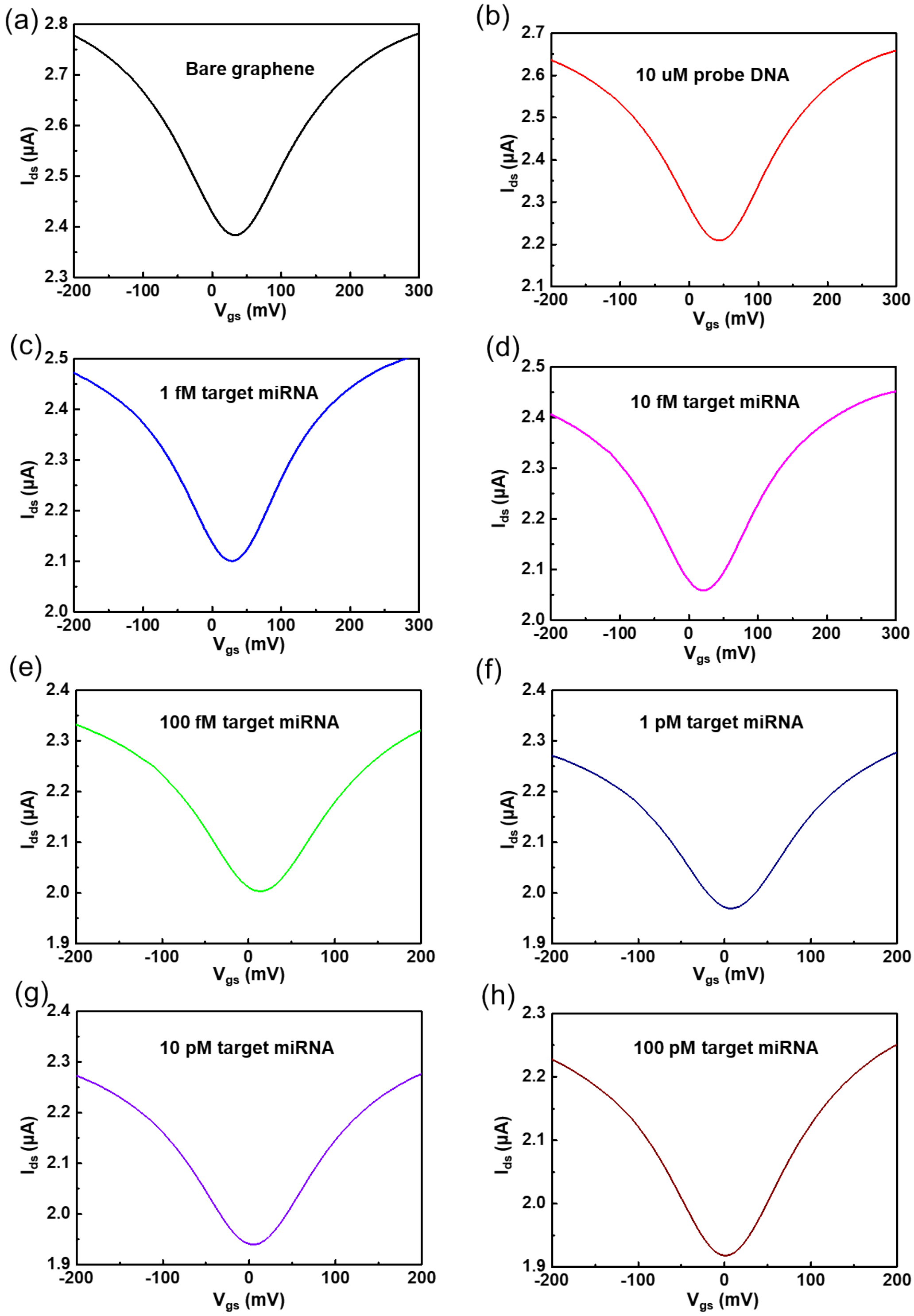

Figure S4. Transfer characteristics of as-fabricated Gr-FET biosensor responding to gate solutions with different target molecules (a) PBS, (b) 10 uM probe DNA, (c) 1 fM target miRNA, (d) 10 fM, (e) 100 fM (f) 1 pM (g) 10 pM (h) 100 fM before bending

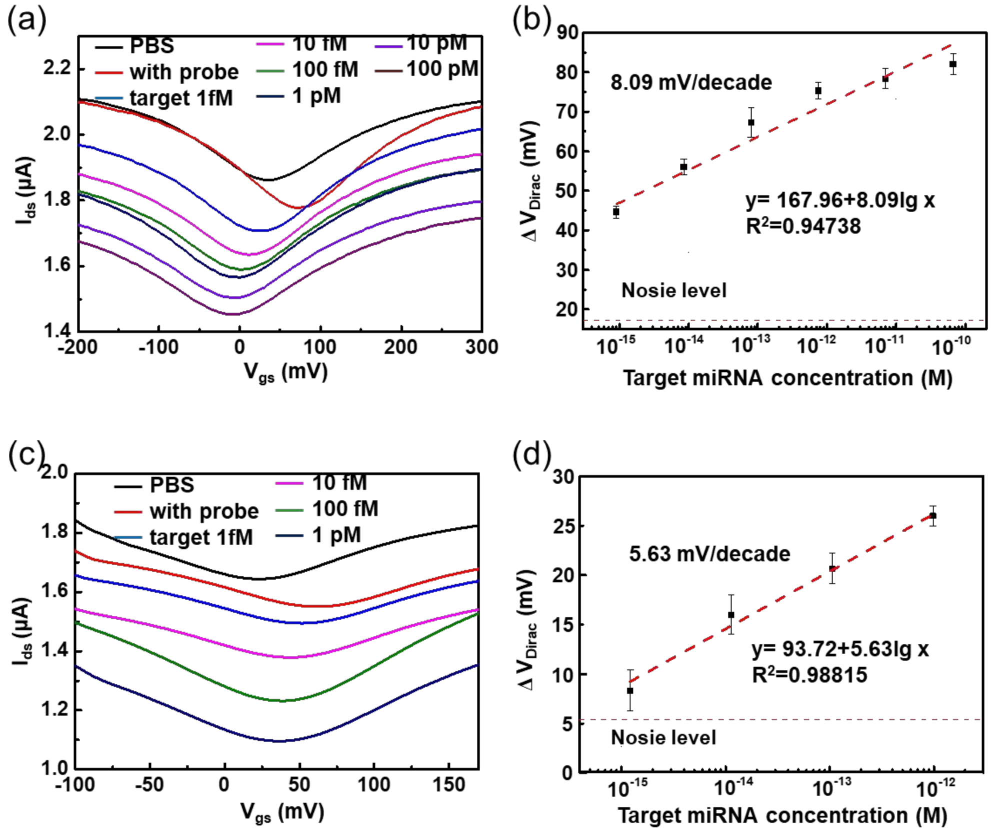

Figure S5. Properties of miRNA sensors in different fabrication batches. (a) Transfer characteristics of as-fabricated Gr-FET biosensor responding to gate solutions with different target molecules. (b) ΔV_{Dirac} dependence of the concentration of target miRNA corresponding to as-fabricated biosensor, and dashed line represents the noise level (~17 mV) from the blank control test; (c) Transfer characteristics of Gr-FET biosensor responding to gate solutions with different target molecules. (d) ΔV_{Dirac} dependence of the concentration of target miRNA corresponding to as-fabricated biosensor, and dashed line represents the noise level (~6 mV) from the blank control test

Table S1. Performance and Structure of Graphene-Based Solution-Gated FET DNA/miRNA Biosensor

FET channel		Linker	Target	Gate electrode	Reaction solution	DNA immobiliza-tion time	Detection limit (M)	Reference
Material	Substrate							
Graphene	Si/SiO_2	None	DNA	Ag	1× PBS	4h	1×10^{-12}	1
Graphene	Si/SiO_2	None	DNA	Ag	PBS①	16h	1×10^{-11}	2
Graphene	Si/SiO_2	PBASE	DNA	Pt	0.01× PBS	2h	1×10^{-11}	3
Graphene	sapphire	PBASE	DNA	Ag/AgCl	0.01× PBS	2h	1×10^{-13}	4
Graphene	Si/SiO_2	PBASE	DNA	Au-planar, integrated	PBS②	14h	1×10^{-17}	5
rGO	Si/SiO_2	Au-S	miRNA	Ag	1× PBS	3h	1×10^{-14}	6
Graphene	Si/SiO_2	PBASE	DNA	Ag	1× PBS	2h	1×10^{-14}	7
Graphene	glass	Au-S	DNA	Au	1× PBS	12h	1×10^{-15}	8
Graphene	PI	Poly A	miRNA	Ag/AgCl	1× PBS	30min	1×10^{-14}	**This work**

Note: ① 0.25 M NaCl and 10 mM PBS; ② 10 mM PBS, 150 mM NaCl and 50 mM $MgCl_2$

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