

Supplementary Materials

A Facile Method for the Non-Covalent Amine Functionalization of Carbon-Based Surfaces for Use in Biosensor Development

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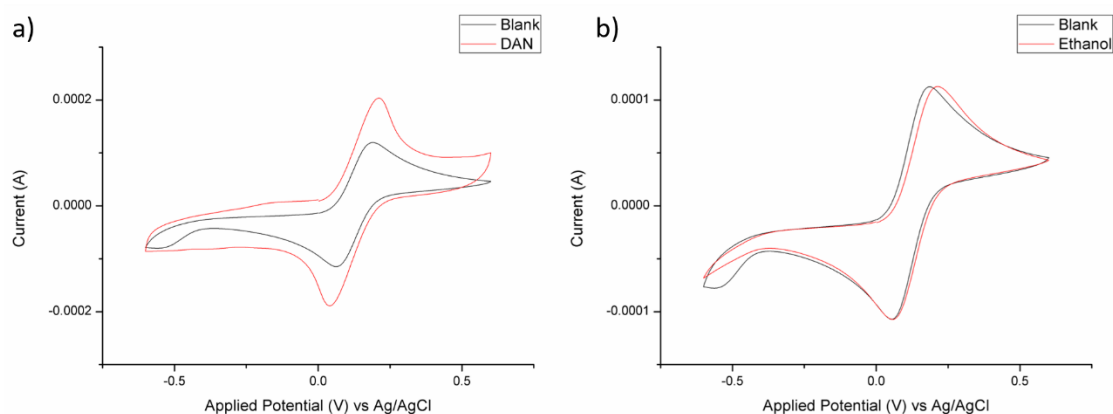


Figure S1. (a) Cyclic voltammograms of a bare graphene (blue) and DAN functionalized (red); (b) Cyclic voltammograms of a bare graphene (blue) and DAN functionalized (orange). CVs were carried out in $[\text{Fe}(\text{CN})_6]^{3-}/[\text{Fe}(\text{CN})_6]^{4-}$ in $1 \times \text{PBS}$ pH 7.4, at a scan rate of 50 mV/s and a potential window of -0.6 – 0.6 V.

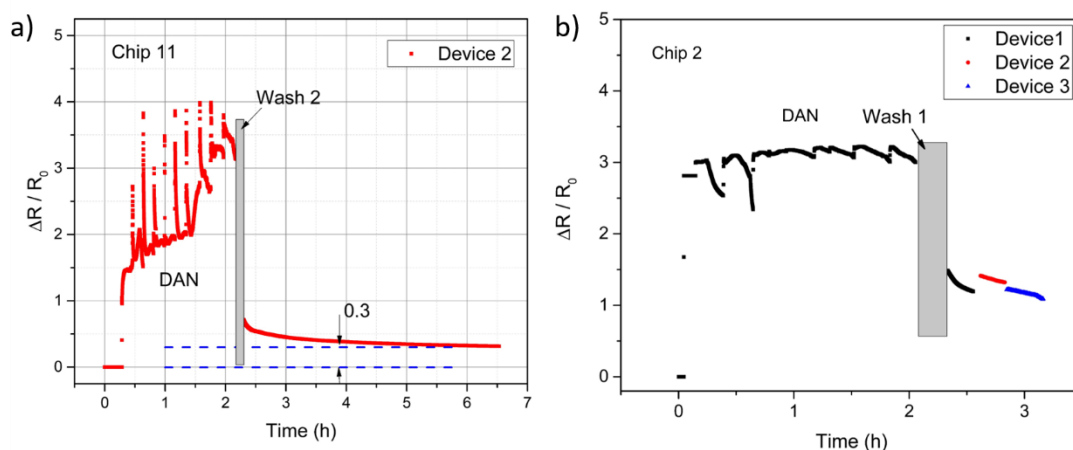


Figure S2. Real-time resistance measurements of the DAN functionalization process. Where $\Delta R = R_{\text{Device}} - R_0$, and R_0 is the initial resistance measurement. (a) 2 h DAN incubation at RT, followed by wash 1 and relaxation; (b) 2 h DAN incubation at RT, followed by wash 1, relaxation of all three resistors on the chip are indicated. Wash 1 = wash with DI water and gently dried with N_2 . Wash 2 = wash with $1 \times$ PBS (pH 7.4), followed by DI water and gently dried with N_2 .

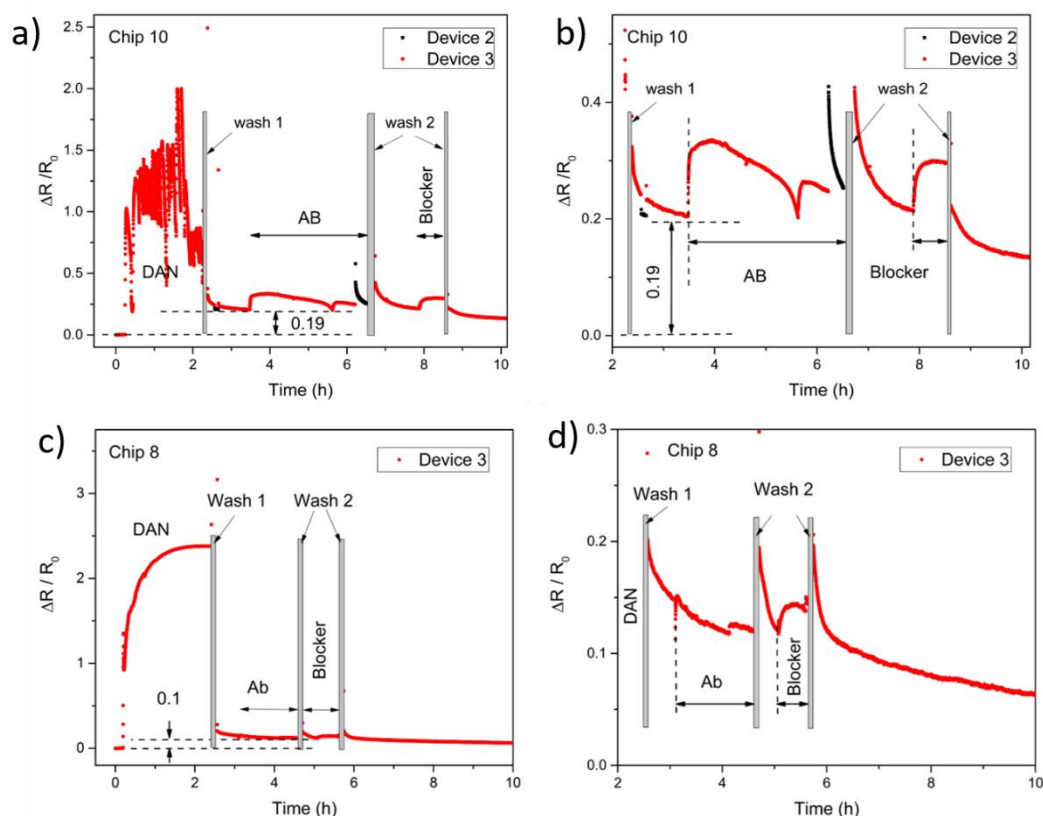


Figure S3. Real-time resistance measurements of the graphene functionalization process. Where $\Delta R = R_{\text{Device}} - R_0$, and R_0 is the intrinsic graphene resistance. (a) Functionalization stages (chip 10); (b) antibody and blocker stages (chips 10); (c) functionalization stages (chip 8); (d) antibody and blocker stages (chip 8). Wash 1 = wash with DI water and gently dried with N_2 . Wash 2 = wash with $1 \times$ PBS (pH 7.4), followed by DI water and gently dried with N_2 .

Confirmation of the presence of amine groups at the graphene surface was investigated by via an amine reactive fluorescent dye. Following surface modification with drop cast DAN, HOPG (Highly oriented pyrolytic graphite) samples were incubated with 100 μ l of amine-reactive fluorescent dye Alexa fluor 568. The dye specifically binds to amine terminated surfaces. The resulting fluorescence microscopy images are shown in Figure S4. As expected, the blank untreated surface showed no fluorescent properties (Figure S4a). However, the drop-cast DAN modified sample exhibited fluorescence following incubation with amine-reactive fluorescent dye Alexa fluor 568, confirming that amine groups are present on the HOPG surface after DAN modification.

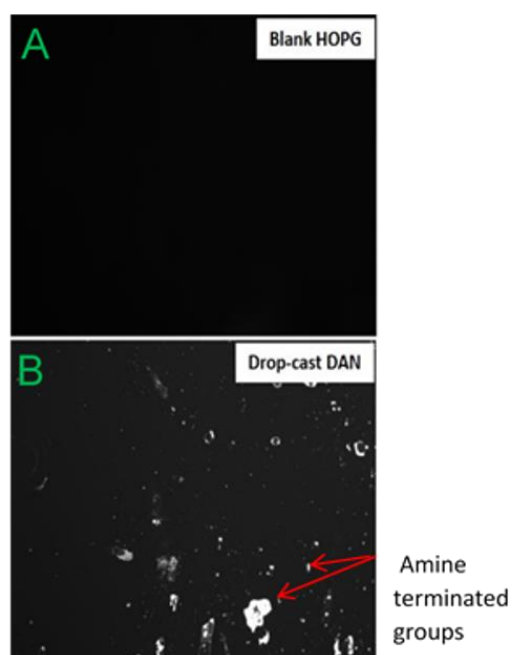


Figure S4. Fluorescence microscopy images taken after incubation of 100 μ l drop of amine dye: (a) blank HOPG control, which exhibits no amine terminated surfaces; (b) drop-casted DAN sample, which exhibits amine terminated surfaces.

a)		b)	
Device Number	$\Delta R/R_0$ Ethanol only	Device Number	$\Delta R/R_0$ 10 mM DAN
1	-0.04883	14	0.10012
2	-0.05041	15	0.07942
3	-0.04838	16	0.05191
4	-0.05375	17	0.05810
5	-0.05444	18	0.07568
6	-0.05640	19	0.06206
7	-0.06302	20	0.08560
8	-0.04917	21	0.01496
9	-0.21631	22	0.00436
10	-0.05772	23	0.15067
11	-0.07085	24	0.12657
12	-0.06543	25	0.10296
13	-0.06660	26	0.10489
	Mean	Mean	0.078253
	SD	SD	0.039485

Table S1. (a) $\Delta R/R_0$ for graphene devices immersed in ethanol (2 h incubation), follow wash 1 (wash 1 = wash with ethanol, followed by DI water and gently dried with N_2); (b) $\Delta R/R_0$ for graphene devices immersed in 10 mM DAN solution (2 h incubation), follow wash 1 (wash 1 = wash with ethanol, followed by DI water and gently dried with N_2).

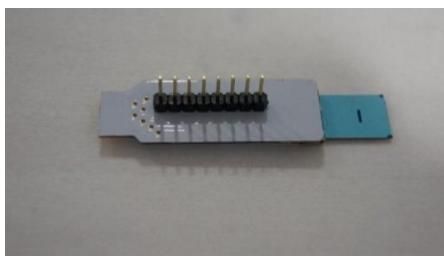


Figure S5. Image of a passivated chip in the Biovici “sensor-Connect” connector for real-time resistance measurements.

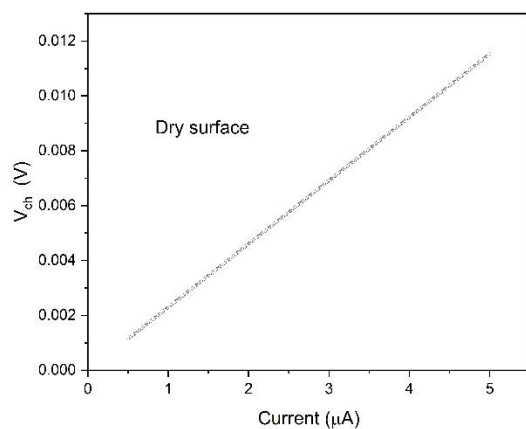


Figure S6. Typical channel resistance linearity over the 0.5 μA –5 μA current range. The I–V characteristics were measured by the four-pole method.