Supporting Information

Controlled Covalent Functionalization of Graphene-Channel of a Field Effect Transistor as Ideal Platform for (Bio)sensing Applications

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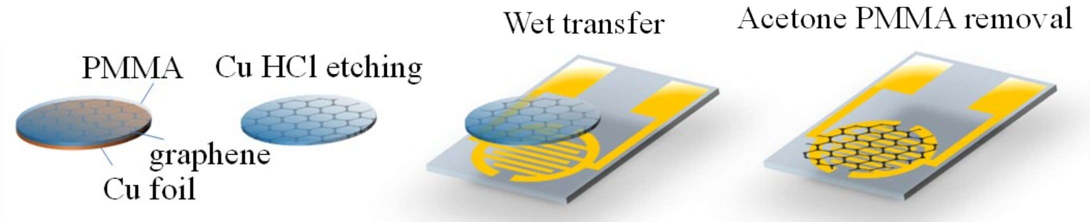


Scheme S1. Process of deposition of CVD graphene on gold-based interdigitated electrodes (IDE). First the backside of the Cu disk is plasma etched to remove the residual graphene, followed by copper foil etching in diluted hydrochloric acid (HCl). The remaining floating graphene sheet, supported by a PMMA layer (60 nm, 495K, A2), is transferred to the IDE chip and annealed for 30 min at 90°C. The PMMA is removed in the final step using a hot acetone washing.

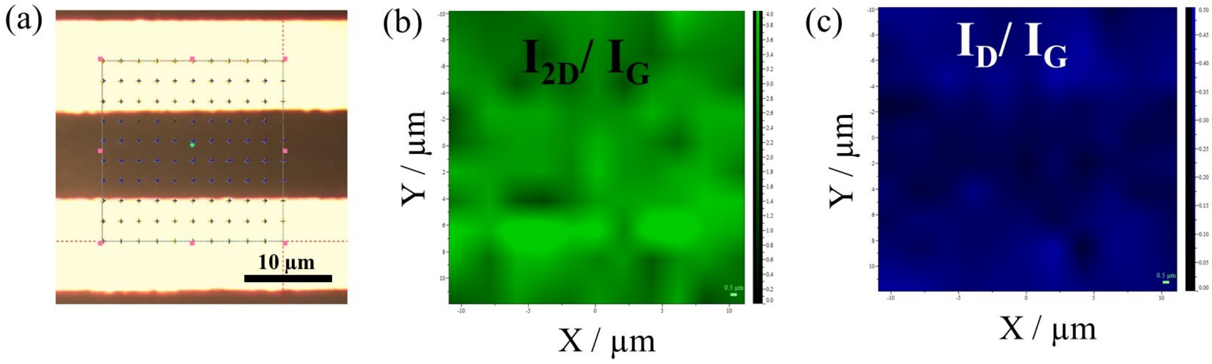
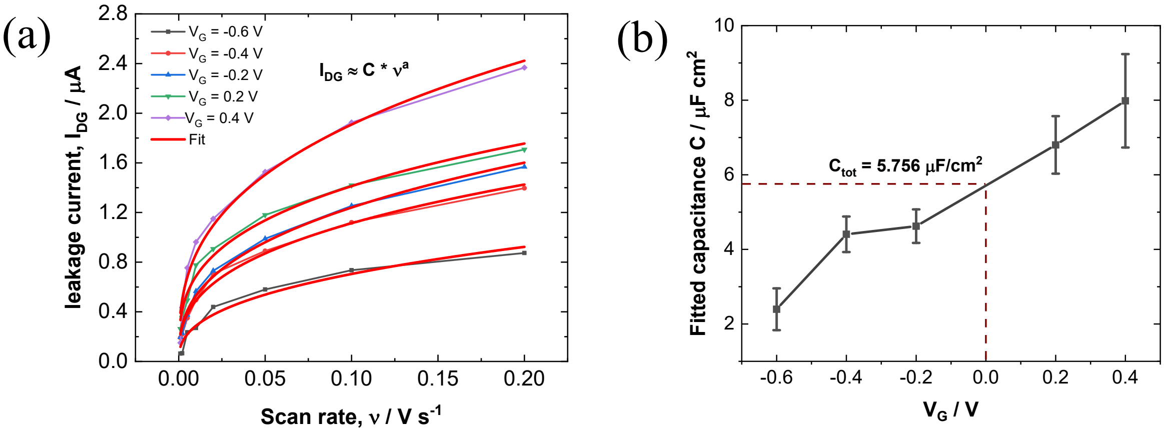
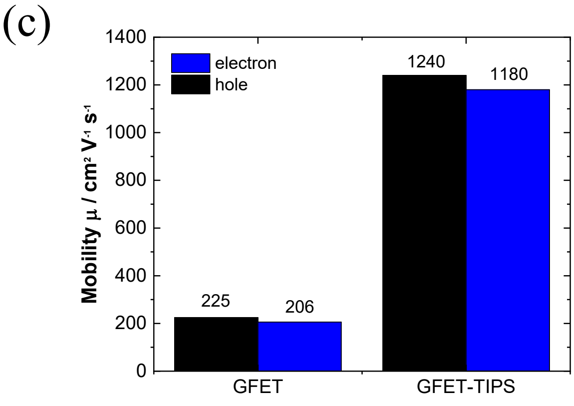


Figure S1. Raman mapping of graphene transferred onto gold based interdigitated electrode (GFET). (a) optical image of the scanned area. (b) I_{2D}/I_G. (c) I_D/I_G.





(d)

	dI_{DS}/dV_G [A/V]		$\mu_{eff} = \frac{dI_{DS}}{dV_G} \times \frac{L}{WV_{DS}C_{EDL}}$ [10^4 cm² V^{-1} s^{-1}]	
	holes	electrons	holes	electrons
GFET	3.18 x 10^{-4}	2.91 x 10^{-4}	2.25 x 10^{-2}	2.06 x 10^{-2}
GFET-TIPS	1.75 x 10^{-3}	1.66 x 10^{-3}	1.24 x 10^{-1}	1.18 x 10^{-1}

Figure S2. Determination of hole and electron mobility: (a) Leakage current vs. scan rate recorded at different applied VG. (b) Fitted capacitance vs. VG. (c) Electron and hole mobility of GFET and TIPS modified GFET. (d) Table summarizing hole and electron mobility values for GFET and GF

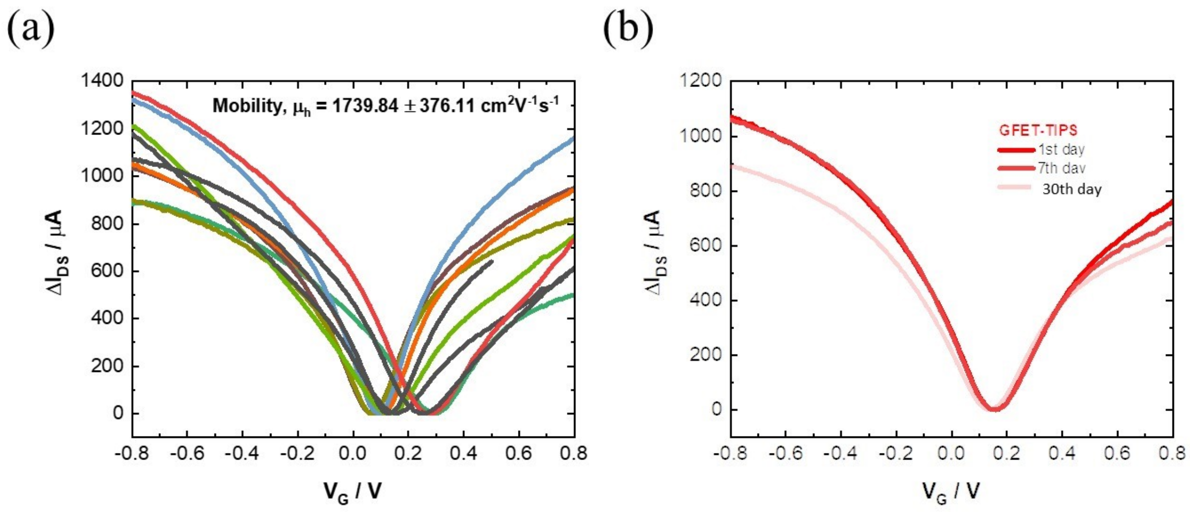


Figure S3. (a) $I_{DS}V_G$ curves of 10 TIPS modified GFET with calculated mobility. (b) Stability of 10 TIPS modified GFETs evaluated after 1 month when stored at room temperature in the dark.

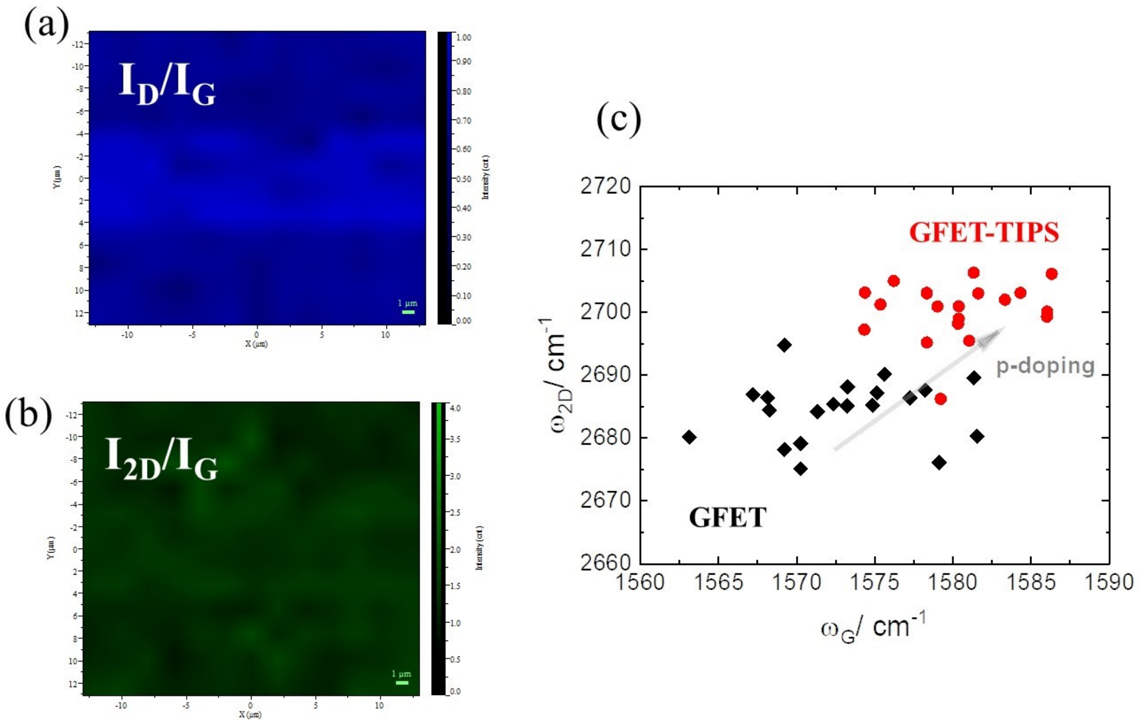
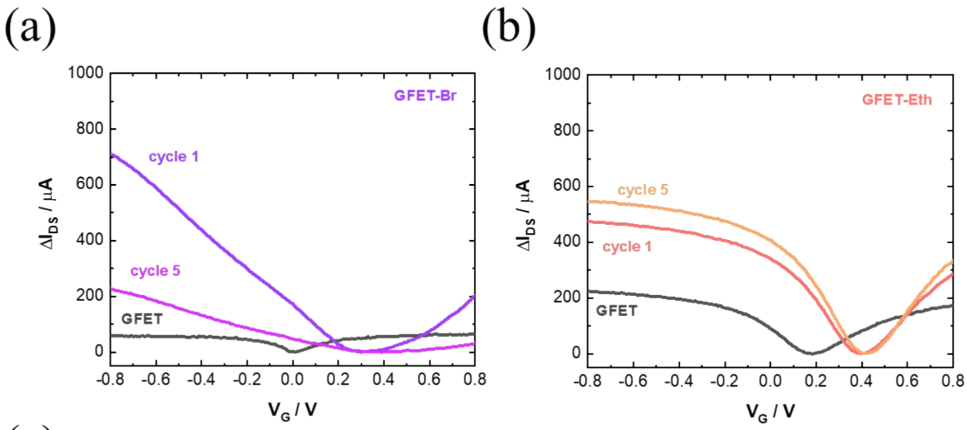


Figure S4. Raman spectroscopy analysis of GFET-TIPS. (a) I_D/I_G. (b) I_{2D}/I_G. (c) Scatter plot of 2D peak position vs. G peak position for GFET, (black, extracted from **Figure S2**) and for GFET-TIPS (red)



(c)

		Mobility [10^4 cm^2 V^{-1} s^{-1}]	
		Holes	Electrons
	initital	335±70	318
4-Eth-Ph-N_2^+	1^{st} cycle	827±32	587±23
	5^{th} cycle	893±20	587±12
4-Br-Ph-N2$^+$	1^{st} cycle	498±22	176±14
	5^{th} cycle	107±12	35±8
4-NO_2-Ph-N_2^+	1^{st} cycle	826±18	455±12
	5^{th} cycle	451±15	177±14

Figure S5. $I_{DS}V_G$ curves of GFETs before and after modification for one or five cycles with different diazonium salts (a) 4-bromobenzene diazonium tetrafluororate (4-Br-Ph-N_2^+). (b) 4-ethynylphenyl diazonium ‘4-Eth-Ph-N_2^+) (c) Table of hole and electron mobilities extracted from Figure S4a-c and Figure 4.

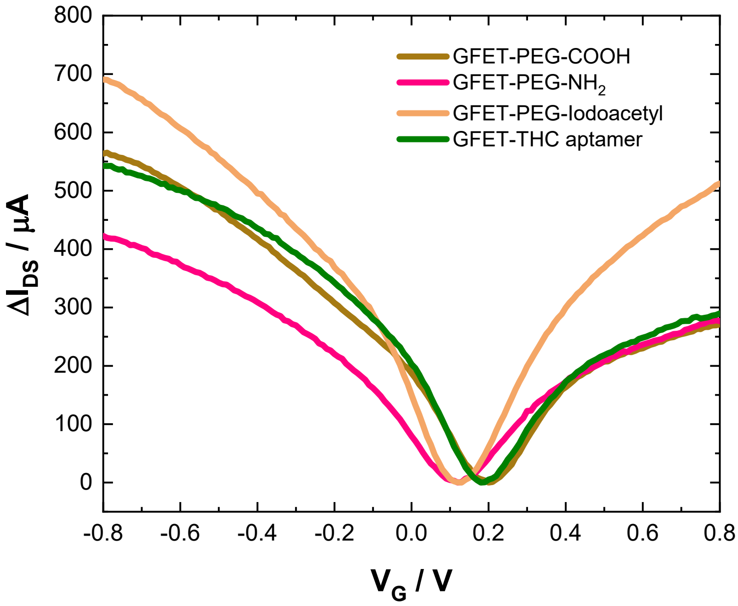


Figure S6: Transfer characteristics of GET-TIPS interfaces modified by click chemistry with different azide-terminated ligands such as azido-PEG-acid (brown), azido-PEG-NH_2 (pink), iodoacetyl-PEG-azide (orange)and a 5'-azide modified tetrahydrocannabinol aptamer (5'-NH_2-TTT-TTT-CTT ACG ACC CAG GGG GGT GGA CAG GCG GGG GTT AGG GGG GTC GTA AG-3') (green)

Table S1: Mobility values of diazonium-modified graphene

Diazonium[a]	Technique	Mobility [$cm^2V^{-1}s^{-1}$]	Ref.
4-NO_2-Ph-N_2^+	Spontaneous grafting	600	1
4-amino-3'-nitroazobenzene diazonium	Spontaneous grafting	580 (hole mobility)	2
4-NO_2-Ph-N_2^+ 4-Me_2N-Ph-N_2^+ 4-CO_2Me-Ph-N_2^+	Spontaneous grafting	500-100 (hole mobility)	3
4-NO_2-Ph-N_2^+	Spontaneous grafting	370 (hole mobility)	4
4-NO_2-Ph-N_2^+ 4-Br-Ph-N_2^+	Electrografting	10	5
4-NO_2-Ph-N_2^+ 4-Br-Ph-N_2^+ 4-Eth-Ph-N_2^+ 4-TIPS-Eth-Ph-N_2^+	Electrografting (5 cycles)	451±15 107±12 893±20 1739± 376	Our work

[a] 4-NO_2-Ph-N_2^+ = 4-nitrobenzene diazonium, 4-Br-Ph-N_2^+ = 4-bromobenzene diazonium, 4-Me_2N-Ph-N_2^+ = 4-dimethylaminobenzene diazonium, 4-CO_2Me-Ph-N_2^+ = 4-methylbenzoate diazonium, 4-Eth-Ph-N_2^+ = 4-ethynylphenyl diazonium, 4-TIPS-Eth-Ph-N_2^+ = 4-triisopropylsilylethynylphenyl diazonium.

Table S2: Mobility values of graphene characteristics before and after interfaces click chemistry

Interface	Hole mobility [$cm^2V^{-1}s^{-1}$]	Electron mobility [$cm^2V^{-1}s^{-1}$]
N_3-PEG-COOH	978±23	1025±51
N_3-PEH-NH_2	839±16	840±51
N_3-PEG-Iodoacetyl	1110±75	1025±54
N_3-THC aptamer	1076±85	1056±34

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