Supporting Information

Graphene Transistors with Multi-functional Polymer Brushes for Biosensing Applications

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Consortium für elektrochemische Industrie, Wacker Chemie AG
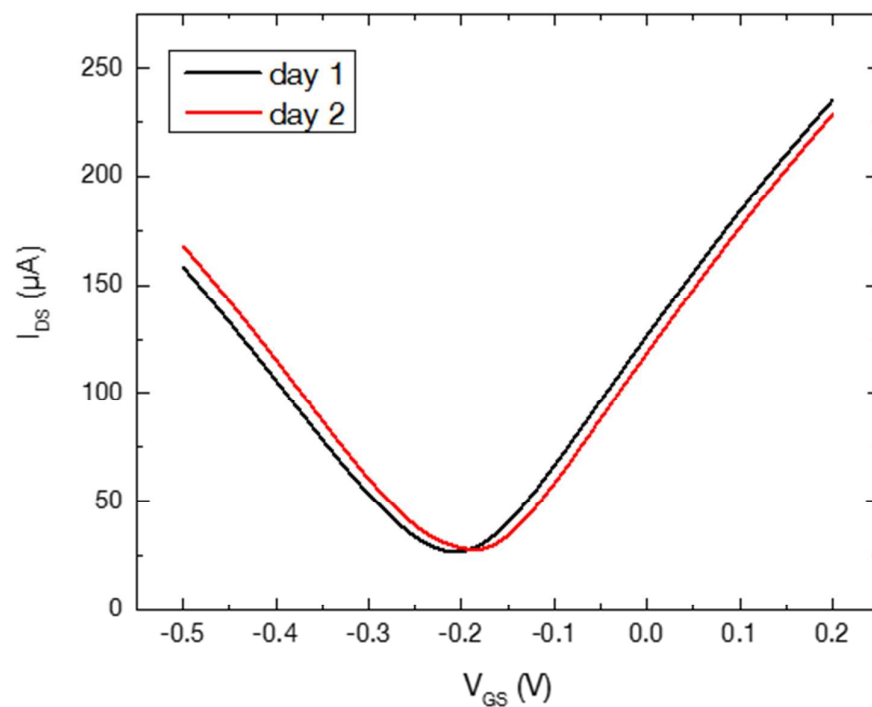Zielstattstraße 20, 81379 München, Germany

Stability

Figure S1: I-V characteristics of a polymer-modified transistor on two different days. The observed curves are practically identical. The observed slope, i.e. the transconductance, does not change over two days of experiments. The small shift can be explained by a slightly different pH of the used electrolyte.
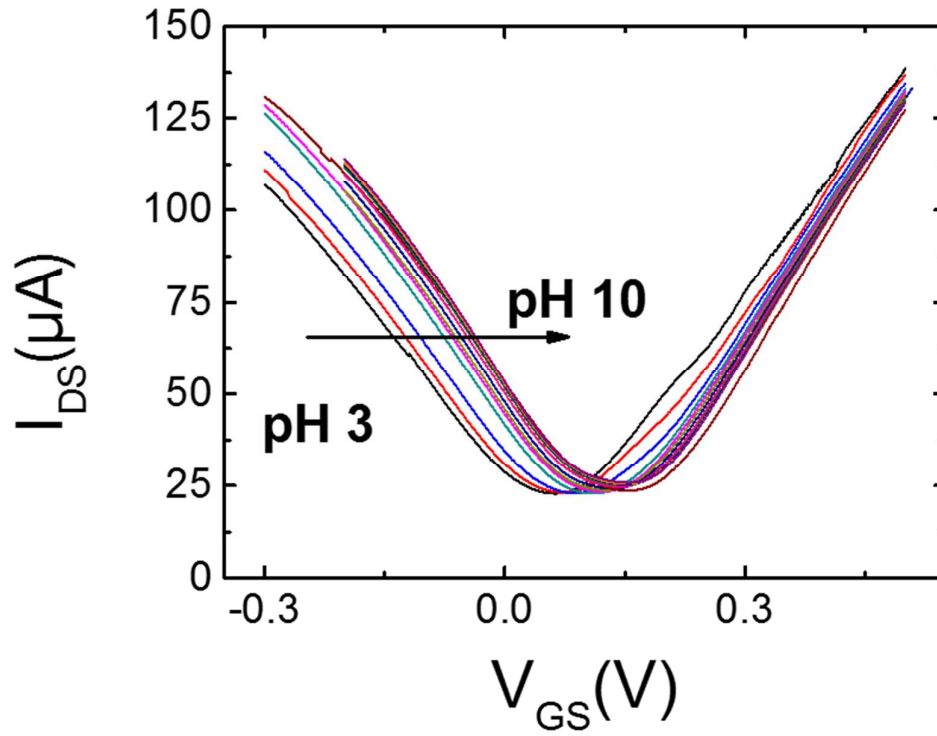
pH measurements

Figure S2: I-V characteristics of a graphene SGFET at different pH

pH model

The local proton concentration at the surface is given by:

$$[H^+] = [H^+]_{bulk} \exp(-e\varphi / k_B T)$$

The acid dissociation constant of the surface group is defined as:

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{[H^+]([A]_0 - [HA])}{[HA]}$$

$$\Leftrightarrow K_a[HA] = [H^+]([A]_0 - [HA])$$

$$\Leftrightarrow 10^{-pK_a}[HA] = 10^{-pH} \exp(-e\varphi / k_B T)([A]_0 - [HA])$$

$$\Leftrightarrow [HA] = [A]_0 \left(1 + 10^{pH-pK_a} \exp(e\varphi / k_B T)\right)^{-1}$$

[HA], [A⁻], $[A]_0$ are the concentrations of protonated, deprotonated, and total groups. As the

charge changes by +e for the protonated groups, the additional surface charge is given by

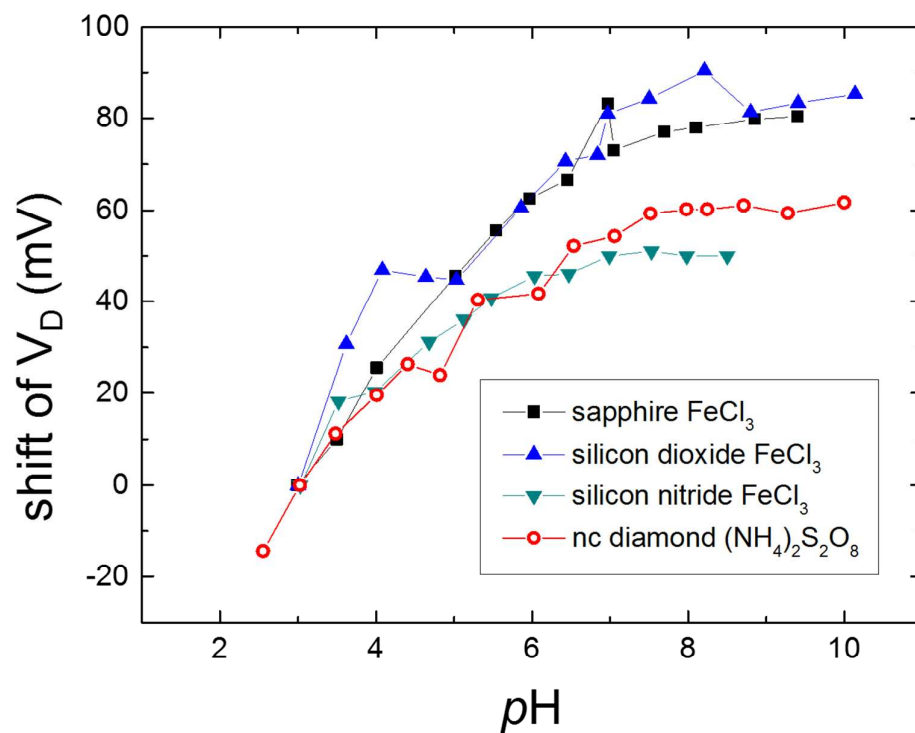$$\sigma_{surf} = [HA]$$

Different substrates and copper etchants

Figure S3: The shift of U_{Dirac} with pH for a bare graphene transistors on different substrates and different copper etchants. All samples exhibited a higher sensitivity at lower pH (<7), and a low sensitivity at higher pH.

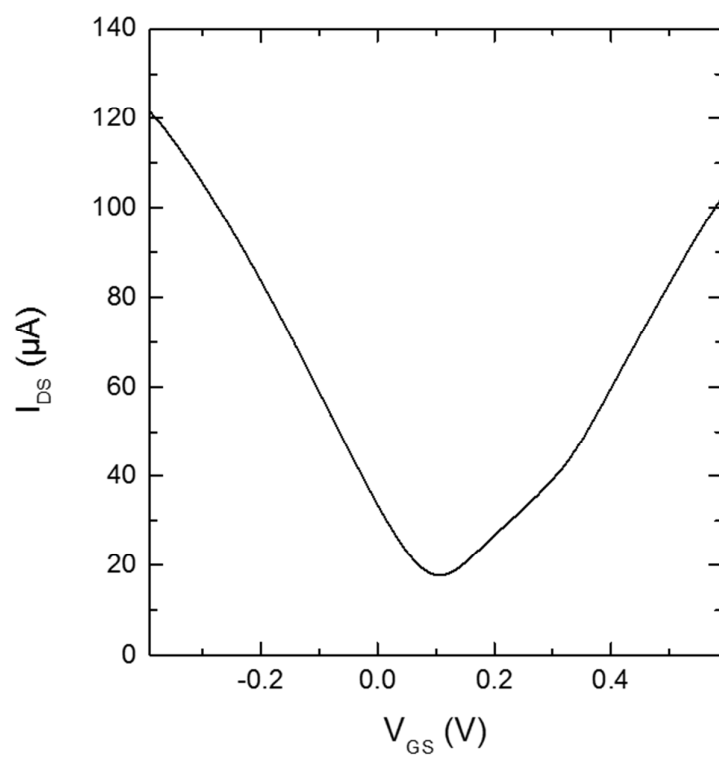Transistor characteristics after functionalization

Figure S4: I-V characteristics after the functionalization with AChE. Similar current values and slopes are observed as for pristine transistors (Fig2c)