Fabrication and biosensing with graphene edges

Gao, J.

Propositions

Accompanying the Ph.D. thesis

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1. At attomolar concentrations, the sensitivity of biosensors based on two-dimensional field-effect transistors is primarily determined by analyte transport and capture, rather than by the electrical response of individual binding events. (Chapter 2 of this thesis)
2. In graphene sensors, the edges are much more sensitive than the basal plane regardless of the chemical functionalization of the edge. (Chapter 3 of this thesis)
3. The covalent modification of graphene edges may change the charge career distribution in the basal plane depending on the type of protecting layer deposited on the basal plane. (Chapter 4 of this thesis)
4. The long-term signal sensitivity of graphene based organic electrochemical transistors is limited by the chemical stability of the transistor, rather than by graphene itself. (Chapter 5 of this thesis)
5. Metal electrodes fabricated by lithography are fundamentally limited in their ability to generate strong dielectrophoretic fields.
6. A mechanically fractured graphene edge exhibits a preference for specific crystallographic orientations depending on the mode of fracture.
7. The stable and reversible surface functionalization of graphene biosensors improves their sensitivities.
8. At physiological ionic strength, the Debye screening length determines the detection limit of label-free electrical sensing devices more than probe affinity.
9. The academic community's preference for constantly pushing the limits of detection rewards the performance of single devices but sacrifices device-to-device error-analysis, which truly determines clinical value.
10. Learning how to identify a scientific question, rather than receiving it from the supervisor, better prepares researchers for scientific independence.

Jianwei Gao

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