Biomolecules on graphene flatlands: Unique interactions and transduction at graphene-based field-effect biosensors

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Use of graphene-based materials (GBMs) as transducers of biomolecular interactions has been at the forefront for development of future diagnostics applications. Availability of highest surface-area with respect to material volume and efficient charge-transport in GBMs while facilitate the efficient charge transduction, a variety of heterogeneities at such two-dimensional interfaces pose unique challenges for real-use as diagnostics solutions, especially towards fulfilling clinical requirements.[1,2]

In this work, we highlight such interfacial heterogeneities of GBMs deployed as field-effect based biosensors. Other than the substrate-interactions, influences from chemical surface-modification, biofunctionalization, critically influence the charge-carrier transport in such electrical devices. Over past years, our studies of graphene-based field-effect devices have focused on optimization of such two-dimensional bionanointerfaces and make effort towards detailed understanding of electrical transduction of dynamic biological interactions. In particular, we present an updated analytical model for such field-effect based bionanosystems that are able to detect and delineate changes in biomolecular characteristics such as surface charge and size. Specific examples of biomolecular systems include thickness changes in DNAs and DNA-protein interactions.

References

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[2] S. Kumar, T. Kurkina, S. Ingebrandt, V. Pachauri*, Organic Bioelectronics for Life Science and Healthcare 2019, 56, 185-242

Figures

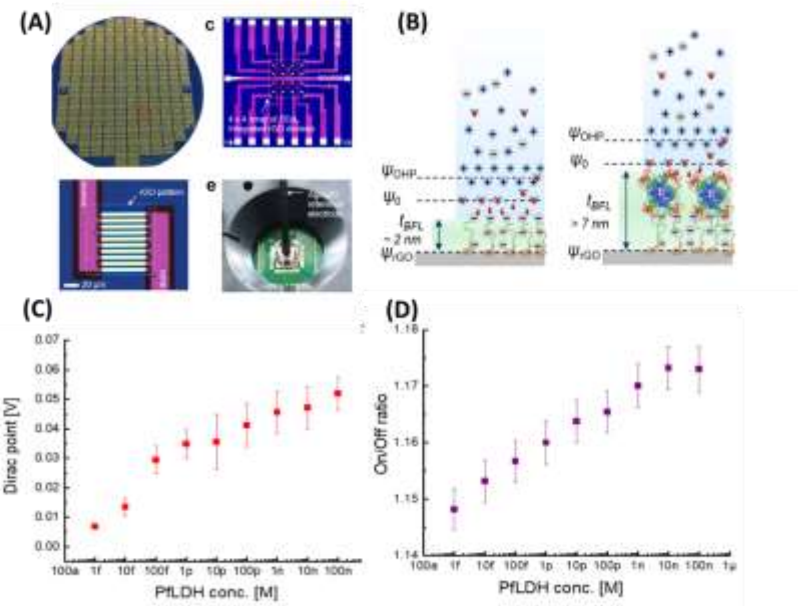

Figure 1: System integrated field-effect biosensors based on GBMs (A) deployed for monitoring of complex biomolecular interactions such as aptamers-proteins (B) display unique electrical transductions related to changes in charges (C) and sizes (D) at the interface.