**Graphene field-effect biosensors for real-time label-free binding kinetics**

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Electronic devices based on single nanostructures show high promise for applications in biosensing. Field-effect sensors permit the direct label-free detection of the analyte without the need for additional reactions, through the monitoring of changes in the electrical characteristics. In addition, nanoscale field-effect devices allow for high sensitivity, enabling the detection of very low concentrations of target analytes [1]. Besides the sensitivity, the selectivity towards a target molecule is another important aspect in the realization of a sensor. In order to provide high selectivity, it is necessary to have a clear understanding of the electrostatic and biochemical properties at the sensor surface. In the talk, we present results pertaining to the charge-potential landscape at the graphene-liquid interface, obtained systematically using field-effect measurements performed in liquid. This enables us to estimate the isoelectric point (pI) or point of zero charge (pzc) of graphene surface [2]. By electrochemical functionalization we decorate bare graphene with a varying density of aromatic molecules and demonstrate that the pI/pzc can be modulated for the application of interest.
Following this, we present a field-effect device for the real-time measurements of the activity of the enzyme human topoisomerase I with its substrate molecules [3]. For this purpose, the impedance of the device is continuously monitored as a function of the gate voltage, applied through an Ag/AgCl reference electrode in contact with the liquid. By monitoring the changes in the transfer characteristics of the device, we can follow the interaction of the enzyme with its DNA substrate in real-time, and we can extract information about the binding kinetics at picomolar concentrations. The results obtained are highly promising for the use of liquid-gated graphene biosensors for the detection of the activity of a wide number of enzymes and for the analysis of the kinetics of various binding interactions.

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