Abstract

Nanoelectronic devices based on individual graphene sheets motivate the vision of portable and compact systems in liquid media for direct trace analysis of analytes and biomarkers as well as for energy conversion and storage on-site. In order to realize this vision, one of the fundamental challenges is to obtain a thorough understanding of the physics and chemistry of the graphene-liquid-interface especially the charge potential landscape, localized electron transfer properties, and the nature of chemical groups at the graphene surface. We utilize electrochemical modification to modify the surface properties such as modulation of the electrostatic charge distribution by aminophenyl groups, \(^1\) selective modification of graphene peripheries by bipolar electrochemistry \(^2\) and direct identification of attached chemical functionalities. \(^3\) Through field-effect and electrochemical measurements we corroborate the physicochemical behaviour of the interface and exploit the gained knowledge in the realization of sensors and batteries. Specifically, sensors based on functionalized graphene enable the real-time measurement of binding kinetics in aqueous media, \(^4\) while on-chip batteries \(^5\) based on two graphene monolayers enable the operation of a pocket calculator for several hours.

References