Abstract

The thesis entitled "Reduced Graphene Oxide-based Functional Materials for the Electrochemical Sensing and Biosensing, and Removal of Toxic Hg(II)" describes the use of carbon-based functional nanomaterials for the development of electrochemical sensing and biosensing platforms to detect and quantify clinically important bioanalytes, environmentally toxic heavy metals and adsorbent for the removal of toxic Hg(II). Functional materials based on nanostructured carbon such as, CNTs, graphene, etc., play an important role in the development of sensor or biosensor due to the very large surface area, very high electrical conductivity, and good biocompatibility. In this study rationally functionalized reduced graphene oxide (rGO) is used for the development of sensing and biosensing platforms and adsorbent for the removal of toxic Hg(II). Electrochemically generated redox active architecture is used for the sensing of NADH, L-lactate and biological thiols. The covalent functionalization of rGO with $–PhNO_2$ moiety and electrochemical generation of surface-confined redox couple rGO-PhNHOH/PhNO for the biosensing of lactate are demonstrated. Novel inorganic–organic 3D hybrid assembly of rGO and (3-mercaptopropyl)trimethoxysilane is developed and the surface-confined –SH groups are tailored with redox active rationally selected 4-methylcatechol by taking advantage of the Michael addition reaction under optimized potential. The redox–tailored hybrid assembly is used for the electrocatalytic sensing of biological thiols. The sensing of uric acid is demonstrated with Au nanoparticle based inorganic–organic hybrid self-assembly. Histamine functionalized rGO is used for the sensing of bisphenol A. S-doped porous rGO is synthesized for the electrochemical sensing and removal of Hg(II). The sensing platform is highly sensitive to detect Hg(II) at sub-parts per billion level. The results described in this thesis show that rGO-based functional materials are very promising for the development of sensors/biosensors for biologically important analytes and removal of Hg(II). Practical applications of the biosensors/sensors have been demonstrated with human serum samples and the results have been authenticated with conventional clinical laboratory methods.

Keywords: Electrochemical sensors/biosensors; Reduced graphene oxide; NADH; L-lactate; Biological thiols, Uric acid; Hg(II); Bisphenol A; Hybrid material; Self-assembling; Redox–tailoring.