

Synthesis and characterization of Ni nanoparticles-dispersed graphene oxide and N-doped phenolic polymer composite electrode for glucose sensors

Pallab Kumar Bairagi¹, Nishith Verma^{1,2*}

¹Department of Chemical engineering, Indian Institute of Technology Kanpur, Kanpur-208016, India

²Center for Environmental science and Engineering, Indian Institute of Technology Kanpur, Kanpur-208016, India

* Corresponding author: nishith@iitk.ac.in, vermanishith@gmail.com

Abstract

At present, development of electrochemical sensors for biomolecules, based on inexpensive and stable carbonaceous electrodes is of prime interest. In this study we have developed for the first time reduced graphene oxide *in situ* dispersed with Ni-nanoparticles and N-doped phenolic polymer-based composite (Ni-rGO/P) as the working electrode, which also serves as the substrate for poly acryl amide (PAA) used as the recognition element for glucose. Notably, PAA was electrochemically grown on Ni-rGO/P. Nitrogen doping (N-doping) was performed using melamine. The prepared materials were characterized using various spectroscopic techniques such as AAS, SEM, RAMAN and XPS. Electrochemical impedance spectroscopy and cyclic voltammetry were used for electrochemical characterization, e.g. measurements of solution and charge transfer resistances, electrochemical active area, and studying electron transfer mechanism for biosensing. Tested with differential pulse voltammetry, the PAA-Ni-rGO/P sensor showed remarkable linearity ($R^2 = 0.99$) over 0.03 – 250 mg dL⁻¹ glucose concentration, high reproducibility (number of experiments = 500, RSD < 5%). The present method and materials can be used for the development of enzymatic as well as non-enzymatic electrochemical sensors for the various other important inorganic and organic analytes.

Keywords: electrochemical sensor, Ni-nanoparticles, reduced graphene oxide, N-doping, composite electrode.