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Nickel/ P nanozeolite modified electrode: A new sensor for the detection of formaldehyde

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Abstract:

Nickel doped P nanozeolite carbon paste electrode (Ni/P-CPE) was employed as simple and efficient sensor for detection of formaldehyde. For this aim, P nanozeolite was synthesized using agro-waste material, stem sweep ash (SSA) as silica source. The synthesized P nanozeolite was characterized by scanning electronic microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD) and Fourier transform infrared (FT-IR). SEM and TEM images show the presence of crystals with nearly spherical shape and size in the range of nanometer. Ni (II) ions were incorporated into the nanozeolite to prepare Ni (II)-doped P nanozeolite (Ni/P). To decrease the overvoltage of formaldehyde oxidation, modified carbon paste electrode with Ni (II)-doped P nanozeolite (Ni/P-CPE) was prepared. The investigations of the electrochemical behavior of formaldehyde oxidation at the surface of Ni/P-CPE were carried out by means of electrochemical techniques such as cyclic voltammetry and chronoamperometry methods in 0.1 M NaOH. P nanozeolite as porous material acts as host for NiOOH formed during the oxidation of Ni (II) in alkaline solution. The modified electrode presents considerable electrocatalytic current density of nearly 15 mA cm⁻² for formaldehyde oxidation. The effects of some parameters such as the different scan rates and formaldehyde concentrations were also investigated to provide catalysis mechanism for formaldehyde oxidation on Ni/P-CPE. Furthermore, amperometric studies showed that the fabricated electrode as the sensing element has a detection capability of 5.8 μM allowing the quantitative analysis of formaldehyde in the concentration range from 0.02 mM to 11.5 mM with high sensitivity (43.07 μA mM⁻¹). Remarkable advantages of the prepared modified electrode such as low detection limit, fast response time (1 s), wide linear range of concentration and high sensitivity make it as good sensor for the selective determination of formaldehyde.

Keywords: Stem sweep ash, P nanozeolite, Modified carbon paste electrode, Formaldehyde.

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