ELECTROCHEMICAL OXIDATION OF AMMONIA BORANE ON METAL NANOPARTICLES MODIFIED POLYMER FILM-GLASSY CARBON ELECTRODE

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Borazane (NH₃BH₃=ammonia borane) is a stable and low-toxic crystalline solid with possibly the highest hydrogen content (19.5wt.%) in chemical compounds. In addition, borazane is stable in water at ambient temperatures. Ammonia borane, which is safe, chemically stable, easy to transport in its dry state and high solubility in water appears as an attractive fuel for fuel cells [1].

The anodic oxidation of NH₃BH₃ is supposed to be as follows:

\[ \text{NH}_3\text{BH}_3 + 6 \text{OH} \rightarrow \text{BO}_2^- + 4 \text{H}_2\text{O} + \text{NH}_4^+ + 6e^- \quad E^0 = -1.216 \text{ V} \]

Hydrolysis as a main unwanted reaction, occurring to some extent in NH₃BH₃ solutions, generates hydrogen gas:

\[ \text{NH}_3\text{BH}_3 + 2 \text{H}_2\text{O} \rightarrow \text{BO}_2^- + \text{NH}_4^+ + 3 \text{H}_2 \]

Competition between NH₃BH₃ oxidation and hydrogen evolutions is a function of electrode material, electrolyte composition and applied potential. To minimize hydrolysis, the electrolyte solution pH can be increased and choose suitable electrode materials to hinder the hydrolysis of the compound [2, 3].

In this study, composites electrodes were prepared by electrochemical polymerization and metal nanoparticles created by electrochemical reduction on the glassy carbon electrode (GCE) surface. A well distributed Au-Pt nanoparticles can be fabricated on polymer films (polypyrrole=PPy, poly p-aminophenol=PPAP, polyaniline=PANI) GCE surface by cyclic voltammetry. Modified electrodes were characterized by cyclic voltammetry, AFM and SEM techniques. The SEM images were shown Figure 1.

There was no electrocatalytic oxidation takes place for ammonia borane (AB) at bare GCE and PPAP/GCE and other polymer film electrodes. The peak of electrocatalytic oxidation of AB was observed about at -0.80V at Au nano particles modified polymer film electrodes and -0.78 V at Au-Pt bimetallic modified PPAP/GCE. oxidation compare to bare and polymer film electrodes in alkaline media.

Figure 1. SEM images of the A) PPAP/GCE and B)Au-Pt/PPAP/GCE.

References