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The Electrochemical Behavior of Bleomycin at A Co/GC Ion Implantation Modified Electrode

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Abstract: In 0.10 mol/L HOAc-NaOAc buffer solution (pH 4.59), a sensitive reduction peak of bleomycin is obtained by linear sweep voltammetry at Co/GC ion implantation modified electrode. Its electrochemical behavior has been studied. The experiments of AES and XPS show that Co is surely implanted into the surface of GCE and improved the electrocatalytic activity.

Keywords: Ion implantation, electrochemical behavior, bleomycin.

Bleomycin (BLM) is an anticancer drug. BLM has been analyzed by osillopolarography[1] and adsorptive stripping voltammetry[2]. However, the electrochemical behavior of BLM at a Co/GCE and its determination have not been reported so far. In this work, the electrochemical behavior of BLM at the Co/GCE has been studied and a new method for the determination of BLM is proposed. This method is simple, fast and reliable.

The electrode material is glassy carbon (GC). JY2 8010 Metal Vapor Vacuum Arc Ion Source is used for ion implantation at an accelerating voltage of 40KeV in the dosage of 5×10^{17} ion Co^{2+}/cm^2. CHI 660M Electrochemical Workstation CH Instruments Inc. (USA). BLM is obtained from the Institute of Materia Medica, Chinese Academy of Medical Science (Beijing), with a purity of 95.5%. A 1.0×10^{-4} mol/L stock standard solution of BLM is stored in the dark. A stock solution of supporting electrolyte is 1.0 mol/L HOAc-NaOAc (pH 4.59) solution. All the chemicals are of analytical reagent grade.

In 0.10 mol/L HOAc-NaOAc (pH 4.59) buffer solution, the peak current is proportional to the concentration of BLM over the range of $5.0\times10^{-8}\sim1.0\times10^{-6}$ mol/L with the detection limit of 2.0×10^{-8} mol/L. The peak potential is -0.73V (*vs.*SCE). This method is used for determination of urine. The results are 11.08, 9.86 and 10.99 μg/ml. The recovery is 94.9～109.6%.

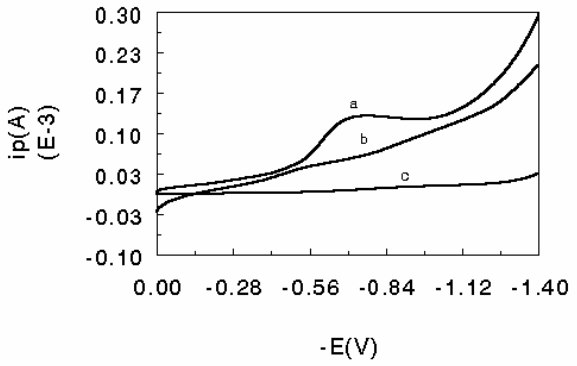
Figure 1 shows the linear sweep voltammograms of BLM. At the GCE, the cathodic peak is very low (curve c); at the Co/GCE, a large and well-defined cathodic peak is observed at-0.73V (curve a), illustrating that Co/GCE has higher catalytic activity for the reduction of BLM.

In the repetitive cyclic voltammograms of BLM, the cathodic and anodic current

hardly changes, indicating that the BLM had no adsorptive characteristic at the Co/GCE. A well-defined peak is observed on the anodic branch, and $i_{pc}/i_{pa}\approx1$, $\Delta E_p=0.20V$, indicating that the reduction of BLM at the Co/GCE is quasi-reversible.

In the effect of scan rate on the peak current, the peak current is linear function of $v^{1/2}$; the relationship between the peak current and v shows a downward - inclined curve, indicating that the reduction of BLM is diffusion controlled.

Figure 1. Linear sweep voltammograms



a. 0.1mol/L HOAc-NaOAc $+1.0\times10^{-6}$ mol/L BLM at Co/GCE
b. 0.1mol/L HOAc-NaOAc at Co/GCE
c. 0.1mol/L HOAc-NaOAc $+1.0\times10^{-6}$ mol/L BLM at GCE

The surface analysis of the Co/GCE surface is also studied. The depth distribution of Co in the surface of the Co/GCE is in good agreement with Gooses normal distribution. Comparing the XPS of the GCE and the Co/GCE shows that Co is implanted into the GCE surface and it stands with the formation CoC. Because Co is introduced into the GCE surface and caused much defect and partial dislocation, the Co/GCE has higher catalytic activity than the GCE.

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