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Electrochemical Behavior of Adriamycin at Ni/GC Ion Implantation Modified Electrode

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Abstract: With a Ni/GC ion implantation modified electrode as working electrode, in 0.1 mol/L HOAc-NaOAc (pH=4.62) solution, a sensitive reductive wave of ADM was obtained by linear sweep voltammetry. The peak potential was -0.55 V (*vs*.SCE). The peak current is proportional to the concentration of ADM with a detection limit of 6.9×10^{-8} mol/L. The behavior of the reduction wave was studied. The experiments of AES and XPS showed that Ni was surely implanted into the surface of the GCE and the implanted Ni at the GCE improved the electrocatalytic activity.

Keywords: Ion implantation modified electrode, electrochemical behavior, adriamycin.

Ion implantation is a kind of new material surface modification technique. Its application offers the following marked advantages: (1) It can implant different ions into different material surfaces according to different desires and requirements to make modified electrodes with catalytic activity; (2) The implanted surface causes defect and partial dislocation to form many active centers, its catalytic activity is much higher than that of the raw material; (3) The ion implantation modified electrode has good stability and reproducibility.

Adriamycin (ADM) is the most prominent member of a family anthracycline antibiotics. ADM has been analyzed by electrochemistry methods[1,2]. In this paper, the electrochemical behavior of ADM at the Ni/GC ion implantation modified electrode is studied and a new method for determination of ADM was proposed.

The electrode material was glassy carbon (GC), which was cut, polished and cleaned by acetone, 1 mol/L NaOH, 1 mol/L HNO_3 and water successively. JY2 8010 Metal Vapor Vacuum Are Ion Source was used for ion implantation at an accelerating voltage of 40 keV in the dosage of 5×10^{17} Ni^{2+}/cm^2. CHI 660 M Electrochemical Workstation CH Instruments Inc. (USA) was used for voltammetry.

In 0.1 mol/L HOAc-NaOAc (pH=4.62) solution, a sensitive reductive wave of ADM was obtained by linear sweep voltammetry. The peak potential was -0.55 V (*vs*.SCE). The peak current is proportional to the concentration of ADM over the range of $5.2\times10^{-7}\sim1.0\times10^{-5}$ mol/L with a detection limit of 6.9×10^{-8} mol/L. This method was used to the determination of ADM in urine. The results were 9.90,9.64 and 9.73 μg/mL. The recovery was 95.1%～104.4%.

In 0.1 mol/L HOAc-NaOAc (pH=4.62), the cathodic peak of the ADM was low and not good at the GCE, while at the Ni/GC ion implantation modified electrode, a large and well-defined cathodic peak was observed at -0.55V, illustrating that the Ni/GC electrode has higher catalytic activity for the reduction of ADM.

The cathodic and anodic peaks were observed at the Ni/GC electrode, and $i_{pc}/i_{pa}\approx1, \Delta E_p=0.10V$, indicating that the reduction of ADM at the Ni/GC electrode is quasi-reversible.

The peak current was a linear function of $v^{1/2}$, indicating that the peak current of ADM is diffusion-controlled.

The ratio of the peak current at the Ni/GC modified electrode i_c to the peak current at the GCE i_d in the solution containing ADM is an important parameter. The i_c/i_d increased with decreasing scan rate, which indicates that the scan rate is slower, but it is more beneficial to the reduction of ADM at the Ni/GC modified electrode. This is evidently characteristic of electrocatalytic reaction.

The experiments of AES and XPS showed that Ni was implanted into the GCE surface and resulted in the formation of NiO. The element Ni was introduced into the GCE surface and caused much defect and partial dislocation, so the Ni/GC ion implantation modified electrode had higher catalytic activity than the GCE.

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References

1. H. Shinji, M. Tsutom, Y. Hisaobu, I. Hideo, *Bunseki Kagaku*, **1986**,*35* (3), 167.
2. E. N. Chaney, R. P. Baldwin., *Anal. Chem.*, **1982**, *54,* 2556.

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