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The Study of Electrochemical Behavior of Dopamine at Nano-gold Modified Carbon Fiber Electrode

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Abstract: The electrochemical behaviors (cyclic voltammetry, CV and different pulse voltammetry, DPV) of dopamine (DA) were studied in this paper. The result indicated that the oxidation of dopamine was controlled by diffusion and adsorption simultaneously at nano-gold (NG) modified carbon fiber electrode (CFE). This modified electrode can separate the peak potentials of dopamine and ascorbic acid (AA). The peak current of DA in DPV curve was found to be linearly proportional to the concentration of DA at range of 2.0×10^{-6}～1.5×10^{-5}mol/L and 1.0×10^{-5}～5.0×10^{-4}mol/L, respectively.

Keywords: nano-gold, carbon fiber electrode, dopamine.

In the field of detection of neurotransmitters carbon fiber ultramicroelectrode has attracted extensive attention due to its specific features such as particular steady state diffusion profiles and very small *IR* drop values as well as the ability to work in living organism[1]. Carbon fiber microelectrodes have been used successfully to detect dopamine *in vivo*[2,3]. The electrochemical behavior of dopamine at nano-gold modified carbon fiber electrode was studied in this paper.

The electrochemical experimental was carried out on an EG&G model 283 Potentiostat/Galvanostat (U.S.A). Carbon fiber electrode (diameter 7μm, length 4mm) was prepared by ourselves and modified with 6 nm nano-gold particles as working electrode[4], a Ag/AgCl (3 mol/L KCl) electrode as reference and a platinum wire as auxiliary electrode.

Figure 1 shows the cyclic voltammograms of 1×10^{-4} mol/L DA at bare CFE (curve a) and NG/CFE (curve b). The separation between the anodic peak potential (E_{pa}) and the cathodic peak potential (E_{pc}) at NG/CFE (ΔE_p=50 mV) reduced about 78 mV compared with that at bare CFE (ΔE_p=128 mV). The heights of oxidation and reduction peak in the same concentration of DA on the NG/CFE are much bigger than that on the bare electrode. All above results suggested that there was the electrocatalytic response of DA at this nano-gold modified carbon fiber electrode.

The relationship between the currents of oxidation peak of DA and scan rates or square root of scan rates were obtained by changing scan rate from 5～180 mV/s shown

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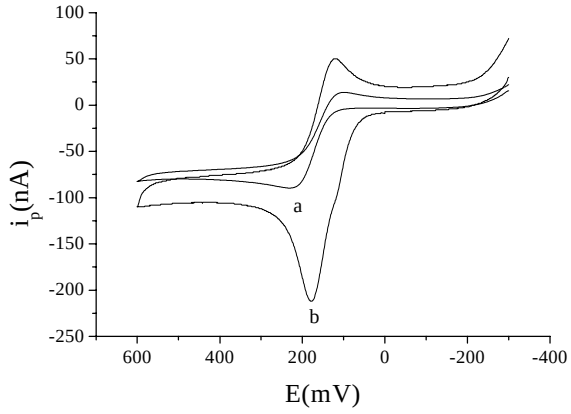
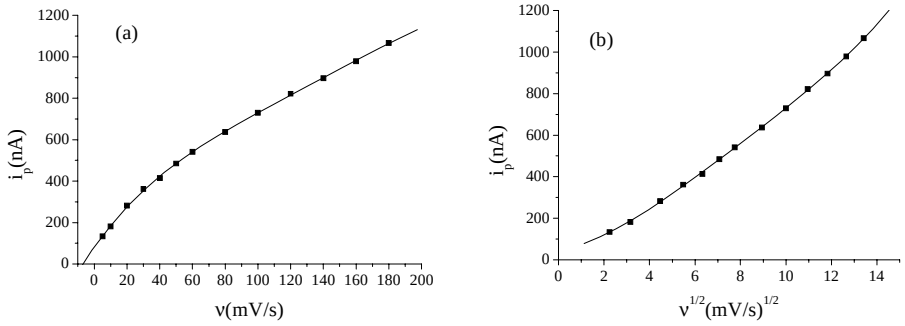
in **Figure 2**. The current of oxidation peak of DA obtained at NG/CFE was linearly neither related to scan rates nor to square root of scan rates, which indicated the oxidation process of DA at NG/CFE is not only controlled by diffusion but also involved a surface process.

Figure 1 CV curves of DA



Concentration of DA 1×10^{-4} mol/L, (a)at bare CFE, (b)at NG/CFE (ν=50mV/s)

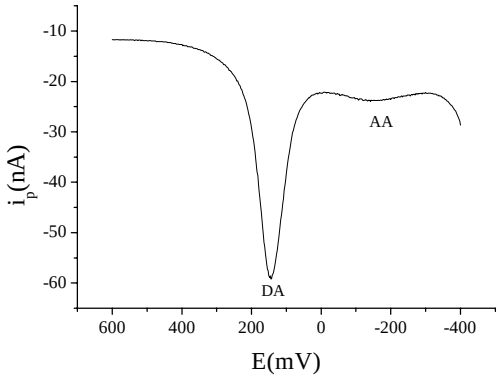
Figure 2 Relationships between currents of oxidation peak of DA and scan rates



(a)scan rates (b)square root of scan rates (ν=5,10,20,30,40,50,60,80,100,120,140,160,180 mV/s)

The different pulse voltammogram of mixture of 5×10^{-5} mol/L DA and 5×10^{-4} mol/L AA was shown in **Figure 3**. Two separated oxidation peak were observed obviously, indicating that NG/CFE can be applied to detect DA in the presence of AA. The peak currents have linear relationship with concentrations of dopamine at range of 2.0×10^{-6}～1.5×10^{-5}mol/L, R=0.999 and 1.0×10^{-5}～5.0×10^{-4}mol/L, R=0.998, respectively.

Figure 3 The different pulse voltammogram of mixture of DA and AA at NG/CFE



DA 5×10^{-5} mol/L, AA 5×10^{-4} mol/L (pulse height:50mV, scan rate:50mV/s)

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