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ORIGINAL PAPER

Synthesis and characterisation of a novel bi-nuclear copper^{2+} complex and its application as electrode-modifying agent for simultaneous voltammetric determination of dopamine and ascorbic acid

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A new binuclear complex of copper^{2+}, $[LCu^{2+}(CH_3COO)_2Cu^{2+}L](CH_3COO)_2$ where L is *N*,*N*-bis(phthalimide)ethylenediamine, was synthesised and characterised. The complex ion $[LCu^{2+}(CH_3COO)_2Cu^{2+}L]^{2+}$ was encapsulated into ZSM-5 zeolite and used to modify the surface of the glassy carbon electrode. This modified electrode, in a phosphate buffer solution at pH 7.0, exhibited an oxidation potential for dopamine (DA) and ascorbic acid (AA) at electrode potentials of 0.230 V and –0.090 V vs. Ag/AgCl respectively, a separation of 0.320 V. The electro-oxidation of DA or AA on the modified electrode is independent of each other. No interference was observed from Na^+, K^+, Cl^-, SO_4^{2-}, Mg^{2+}, Ca^{2+}, Zn^{2+}, Fe^{2+}, and glucose. The detection limits obtained were 2.91×10^{-7} M for DA and 3.5×10^{-7} M for AA.

Keywords: ascorbic acid, dopamine, ZSM-5 zeolite, voltammetry, sensor

Introduction

Copper complexes are probably the metal complexes most intensively studied, being important in a wide variety of fields such as catalysis, biomimetics, spectroscopy, magnetism, liquid crystals, and basic coordination chemistry, etc. However, there are very few reports on copper complexes as an electrode-modifying agent, due to the instability of the changed structure during the redox process. Hence, discovering a new copper complex as an electrode-modifying agent for the detection of analytes is a matter of some importance.

Dopamine (DA), an excitatory neurotransmitter, plays an important role in several important physiological functions, such as renal, central nervous, hormonal, and cardiovascular functions (Damier et al., 1999). Deficiency in DA leads to neurological diseases such as Parkinson's disease, Alzheimer's disease, and schizophrenia (Martin, 1998; Wightman et al., 1988) and is also related to HIV infection (Rohr et al., 1999). The major obstacle impeding the voltammetric determination of DA is interference from ascorbic acid (AA). In biological samples, AA coexists with DA, exceeding it by 10- to 1000-fold (Dayton et al., 1980), and has an overlapping oxidation potential with DA on solid electrodes. Modified electrodes are extensively used to overcome the problem of AA interference in DA determination (Arrigoni & Tullio, 2002; Raoof et al., 2005; Dursun & Nişli, 2004; Shahrokhian & Karimi, 2004). A wide variety of agents have been reported as electrode-modifying agents in order to develop an electrochemical sensor for DA, of which the following are a selection: didodecyldimethylamine bromide (Volkov et al., 1980), poly(vinyl alcohol) (Xiao et al., 2007), composite polymers (Bustos et al., 2007), dendrimers containing gold nanoparticles (Raoof et

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