

Electro-oxidation of phenol and its derivatives on *poly*-Ni(OH)TPhPyPc modified vitreous carbon electrodes

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Abstract

The electrochemical oxidation of phenol and its derivatives using *poly*-nickel hydroxy tetraphenoxypyrrrolephthalocyanine (*poly*-Ni(OH)TPhPyPc) modified vitreous carbon electrodes are described. The films were formed by the electro-transformation of the electropolymerized pyrrole-substituted phenoxyphthalocyanine *poly*-NiTPhPyPc modified electrode in aqueous 0.1 M NaOH solution. The *poly*-Ni(OH)TPhPyPc films showed better stability and resistance to electrode fouling compared to *poly*-NiTPhPyPc and unmodified electrodes. The resistance to surface fouling and stability can be attributed to the structure of the ring substituent on the phthalocyanine macrocycle and to the particular O–Ni–O bridged architecture of the nickel phthalocyanine film.
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1. Introduction

Recent decades have seen a considerable effort invested in the determination of phenolic compounds in environmental, industrial, food and clinical matrices. Facile electrochemical oxidation of phenol and its derivatives at solid electrodes has been reported [1–3], but it is usually marred by the irreversible fouling of the electrodes as a result of the formation of non-conducting/passivating polymer films derived from electrogenerated phenoxy radicals [4,5]. A number of factors have been reported to affect the extent of surface passivation, such as phenol concentration, structure of the phenolic compound and operational conditions. Electro-oxidation of phenol produces tars on the electrode surface that slow down oxidation with characteristic low permeability and

strong adhesion to the electrode [6,7]. Thus a wide range of surface treatment and modification approaches has been used for the prevention of surface fouling and restoration of electrodes during detection of phenolic compounds [8–10].

Chemically modified electrodes using transition metal complexes provide strategies for improving the performance of solid electrodes by incorporating catalytic sites at the electrode|solution interface [11,12]. The redox properties of transition metal phthalocyanines, porphyrins, Schiff bases etc. can be used to provide an electrocatalytic membrane for the voltammetric/ampereometric measurement of species [13,14]. In particular, Ni(II) macrocycles have been shown to be good electrocatalysts for the oxidation of phenols and chlorophenols [15,16]. Nickel macro complexes (cyclam, salen, porphyrins, phthalocyanines etc.) in alkaline aqueous solution offer efficient electrode molecular materials for the electrocatalytic activation of alcohols, phenols, urea,

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