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Electrooxidation of cresols on carbon electrodes modified with phthalocyaninato and octabutoxyphthalocyaninato cobalt(II) complexes

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Abstract

Glassy carbon electrodes (GCE) modified with cobalt(II) phthalocyanine (CoPc-GCE) and cobalt(II) octabutoxyphthalocyanine (CoOBuPc-GCE) were employed for the electrochemical analysis of *ortho*-, *meta*-, and *para*-cresols. The oxidation potential of *p*-cresol was shifted towards less positive values to a larger extent, when compared to *m*- and *o*-cresols, on CoOBuPc-GCE. However, the GCE was less stable when modified with CoOBuPc than with CoPc. This is explained using the possible differences in the orientation of the adsorbed phthalocyanine molecules on the electrode. Bulk electrolysis of *p*-cresol at anodic potentials (1.0 V versus Ag|AgCl) on carbon electrodes modified with CoPc resulted in the formation of radicals which coupled to form trimeric products. On unmodified carbon electrodes, coupling of the radicals resulted in dimeric products following bulk electrolysis. The products formed following bulk electrolysis were characterized by liquid chromatography coupled with mass spectrometry.

Keywords: Cresol; Oxidation; Cobalt; Phthalocyanine; Electrolysis

1. Introduction

Selective oxidation of the ring or side-chains of aromatic hydrocarbon compounds is of importance in organic synthesis and industrial chemistry due to the potential production of fine chemicals for applications such as pharmaceutical drugs, perfume compositions, and pesticides. Electrochemical oxidation of aromatic hydrocarbons has attracted attention due to its selectivity and cleanliness. The electrochemical oxidation of cresols (particularly *p*-cresol) to hydroxybenzaldehydes is of industrial importance [1]. Because the oxidation of cresols occur at easily accessible potentials, voltammetry may be used in their quantification. However, as with other phenolic compounds, radicals produced following oxidation of cresols at solid electrodes couple to form polymeric species which adsorb onto the electrode and deactivate it. There have been some reports on the modification of electrodes using electroactive conducting polymers which have been shown to prevent such deactivation of electrodes by oxidation products of cresols [2]. Relatively stable response was obtained on glassy carbon electrodes (GCE) modified with poly(3-methylthiophene) for the detection of cresols and other phenolic compounds [2]. Horseradish peroxidase-modified graphite and carbon paste electrodes have been used as biosensors for the determination of cresols and other phenolic compounds [3].

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