



Unique electrochemical behavior of tantalum(V) phthalocyanine

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ABSTRACT: The electrochemical and spectroscopic behavior of tantalum(V) phthalocyanine are presented. The NMR spectra is consistent with the lack of symmetry of the complex. Cyclic (CV) and square wave (SWV) voltammetries, and spectroelectrochemistry, were employed in the study of the complex. Two one-electron reductions and a simultaneous 4-electron reduction were observed. Reduction occurs first at the metal to form a Ta(IV) species, followed by ring based processes. Copyright © 2006 Society of Porphyrins & Phthalocyanines.

KEYWORDS: tantalum phthalocyanine, cyclic voltammetry, spectroelectrochemistry, symmetry.

INTRODUCTION

Over the past seven decades, there has been considerable interest in the study of metallophthalocyanines [1]. Various phthalocyanine derivatives exhibit outstanding physicochemical properties due to either the nature of the peripheral or non-peripheral substitution and to changes in the central metal center.

Although extensive investigations have been done on transition metal derivatives [1], very little is known about tantalum-containing phthalocyanines. The synthesis and the X-ray crystal structure of ring unsubstituted tantalum complex have been reported [2].

A need for the elucidation of electrochemical properties of Ta phthalocyanine complexes is required as their solution electrochemistry is unknown. An analytical tool such as cyclic voltammetry (CV) has been widely used to acquire electrochemical information of various complexes. Considerable information such as thermodynamics of redox processes, adsorption processes and kinetics of homogeneous and heterogeneous electron transfer reactions can be

rapidly provided by CV [3-7].

Using redox potentials obtained from CV, the redox chemistry of molecules can also be studied by spectroelectrochemistry [8-13]. Using optically transparent thin-layer electrochemical (OTTLE) cell [14], this work reports on the electrochemical characterization of tantalum(V) phthalocyanine. Ta^VPc complexes have potential as catalysts for the polymerization of alkenes in a similar manner as vanadium phthalocyanine complexes [15].

EXPERIMENTAL

Materials and equipment

Methanol, acetone, benzene, dimethylformamide (DMF), and chloroform (CHCl₃) were dried and distilled before use. Deuterated chloroform (CDCl₃) was dried over magnesium sulphate. Tetrabutylammonium tetrafluoroborate (TBABF₄), TaCl₅ and phthalonitrile (recrystallised from ethanol) were purchased from Sigma-Aldrich.

UV-vis spectra were recorded on a Cary 500 UV-vis/NIR spectrophotometer. IR (Nujol) was recorded on a Perkin-Elmer spectrum 2000 FTIR spectrometer. ¹H NMR and ¹³C NMR spectra were recorded using a Bruker EMX 400 MHz NMR spectrometer. MALDI

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