



Effects of axial ligands on the photophysical properties of silicon octaphenoxypthalocyanine

M. David Maree^a, Tebello Nyokong^{*a}, Klaus Suhling^b and David Phillips^b

^a Chemistry Department, Rhodes University, Grahamstown, 6140, South Africa

^b Department of Chemistry, Imperial College of Science, Technology and Medicine, London, SW7, 2BZ, UK

Received 18 June 2002

Accepted 15 October 2002

ABSTRACT: The photochemistry and photophysics of six axially substituted silicon phthalocyanines are reported and show the importance of the axial groups in the photochemistry of these compounds. The fluorescence quantum yields are especially affected by the axial ligand. A very good correlation was found for the experimentally determined fluorescence lifetimes and the theoretically determined lifetimes using the Strickler-Berg equation for the unaggregated molecules. Copyright © 2002 Society of Porphyrins & Phthalocyanines.

KEYWORDS: silicon phthalocyanine, triplet lifetime, triplet quantum yield, fluorescence lifetime, fluorescence quantum yield, Strickler-Berg.

INTRODUCTION

Recently, phthalocyanines have found application in many fields of science including photodynamic therapy [1], non-linear optics, infrared detection, gas sensing and compact disc technology [2]. Practically all these applications rely on the interaction of the phthalocyanines with light. Our interest is in the photodynamic therapy application of these compounds due to the limitations of the currently approved sensitising dyes in this field.

The structural features of the ideal sensitiser are still not fully determined but some requirements are known such as the inclusion of a diamagnetic metal in the central cavity of the phthalocyanine. It has also been claimed that the sensitizer as a whole should be moderately hydrophobic [3] and in some cases amphiphilic [4]. We are interested in the fluorescence lifetime imaging (FLIM) properties of these molecules due to the potential imaging applications in photodynamic therapy. Fluorescence lifetimes (τ_F) may be indirectly determined using the equations derived by Strickler and Berg [5] using

the absorption and emission spectra of a specific compound. Many restrictions, however, apply as to which type of compound gives a correct value of τ_F and there is a dependence of τ_F on the solvent and the solution temperature [6].

Metallophthalocyanine (MPc) complexes containing central metals which can bind two ligands in the axial position such as Si(IV) are of great interest since axial ligands prevent aggregation through steric hindrance on each side of the ring. Aggregation lowers the lifetimes of the triplet state, resulting in low singlet oxygen quantum yields. Also the use of appropriate ligands may result in complexes with a lipophilic character. Silicon phthalocyanine complexes are a subject of intense investigation due to their potential use as photosensitizers in photodynamic therapy. The properties of the axially substituted Si^{IV}Pc(L)₂ vary extensively with the nature of the axial ligand [7, 8, 9]. SiPc complexes containing Si-O bonds have in particular received considerable attention [7, 10, 11]. We have earlier reported on a series of silicon octaphenoxypthalocyanine complexes containing different axial substituents [12, 13]. This work reports on the fluorescence and other photophysical properties of silicon octaphenoxypthalocyanine (SiPc) derivatives shown in Fig. 1.

*Correspondence to: Tebello Nyokong, email: T.Nyokong@ru.ac.za, fax: +27 46-6225109