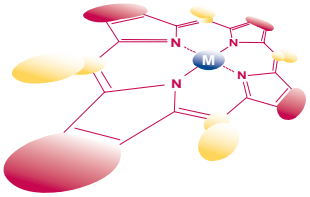
Journal of Porphyrins and Phthalocyanines
J. Porphyrins Phthalocyanines 2005; **9**: 121-129

Published at http://www.u-bourgogne.fr/jpp/



Effects of central metal on the photophysical and photochemical properties of non-transition metal sulfophthalocyanine

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Received 25 August 2004
Accepted 21 October 2004

ABSTRACT: The photophysical and photochemical properties and quenching (by 1,4-benzoquinone) of metallophthalocyanine sulfonates of aluminium ($AlPcS_{mix}$), zinc ($ZnPcS_{mix}$), silicon ($SiPcS_{mix}$), germanium ($GePcS_{mix}$) and tin ($SnPcS_{mix}$) are presented. The quantum yield values of fluorescence (Φ_F), triplet state (Φ_T), singlet oxygen (Φ_Δ) and photodegradation (Φ_d) were determined and the observed trends in their variation among the complexes discussed in terms of aggregation and the heavy atom effect. 1,4-benzoquinone effectively quenched the fluorescence of the complexes. Quenching analyses gave positive deviations from Stern-Volmer behavior, suggesting the existence of static quenching in addition to dynamic quenching. The static and dynamic components of the quenching were separated using a modified Stern-Volmer equation and the "sphere of action quenching model". The quenching constant was found to be a function of the radius of the central metal ion. Copyright © 2005 Society of Porphyrins & Phthalocyanines.

KEYWORDS: phthalocyanines, triplet state, singlet oxygen, photobleaching, fluorescence quantum yields, benzoquinone, quenching, Stern-Volmer.

INTRODUCTION

The chemistry of porphyrins and phthalocyanines has continued to attract considerable interest because of their diverse applications. Phthalocyanines (Pc's) have found use as light absorbing layers in re-writable optical media [1, 2], chemical sensors [3, 4], photoconducting materials in laser printers [5], in non-linear optics [6, 7], in photovoltaic cells [8] and as colorants (dyes and pigments). Most notable among the uses of Pc's is as photosensitizers in oncology, particularly in photodynamic therapy (PDT) [9-14]. For PDT action, it is necessary that the drug be easy to administer via injection into the blood stream. As the blood itself is a water-based system, water solubility then becomes an essential requirement for a PDT drug. Additionally, the drug will have to traverse lipid membranes – consequently, it should also be lipophilic. The question now is how to produce a water-soluble lipophilic drug. Mixed-sulfonated aluminium phthalocyanine ($AlPcS_{mix}$) commercially known as Photosens® has been developed as a PDT drug in Russia, and has been used in hospitals with a fair measure of success [14]. The study of the photophysical and photochemical behavior of water soluble MPc complexes is of importance for their potential application in PDT. Thus in this work we report on the triplet state, singlet and fluorescence quantum yields as well as the photostability of non-transition metal Pc sulfonates ($MPcS_{mix}$, where M = Al, Zn, Si, Ge and Sn) under biological pH conditions.

The study of fluorescence quenching using phthalocyanine compounds (which are related to biologically important chlorophyl) is of interest, since chlorophyl is known to emit its energy as fluorescence once isolated from plants' leaves. The fluorescence could however be prevented by the use of an appropriate quencher. There are two modes

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Published on web 04/22/2005