



Article Type : Research Article

Received : April 7, 2025

Revised : June 23, 2025

Accepted : August 1, 2025

DOI : [10.17798/bitlisfen.1670251](https://doi.org/10.17798/bitlisfen.1670251)

Year : 2025

Volume : 14

Issue : 3

Pages : 1519-1533



SYNTHESIS AND ELECTRONIC PROPERTIES OF AXIALLY DISUBSTITUTED SILICON (IV) PHTHALOCYANINE 9- PHENYL-9H-XANTHENE-9-OXY

Derya GÜNGÖRDÜ SOLĞUN¹

¹ Van Yüzüncü Yıl University, Department of Chemistry and Chemical Business Technologies, Laboratory
Technology Program, Van, Türkiye, deryagungordu@yyu.edu.tr

ABSTRACT

In this research, a new axial phthalocyanine complex compound was synthesized. This study involved the synthesis of the novel silicon phthalocyanine prepared by reacting SiPcCl₂, 9-phenyl-9H-xanthen-9-ol and K₂CO₃ in dry toluene. The novel silicon phthalocyanine was characterized by using different spectroscopic techniques including ¹H NMR, UV-Visible, FT-IR and mass spectroscopy. The electronic properties of the compound for example the aggregation and solubility parameters investigated. Aggregation is a crucial parameter dictating the functional performance of phthalocyanines. Aggregation is closely related to temperature, concentration, type of ligand attached to the phthalocyanine ring, substituents attached to peripheral positions and polarity of the solvent. Ligands attached to the phthalocyanine ring disrupt the planarity of the ring, resulting in reduced aggregation. For these reasons, in this study, we focused on the aggregation characteristics of phthalocyanines and how axial ligand modifications regulate this behavior. Axial ligand (especially those with metals like Si, Ge, Sn) coordination increases steric bulk and reduces stacking. The low aggregation tendency of phthalocyanines provides significant advantages, especially in photodynamic therapy (PDT), optoelectronics and sensor applications. Photodynamic therapy (PDT) is a light based therapeutic modality that requires the coordinated presence of three key components: a photosensitizer (PS), a light source, and molecular oxygen. Phthalocyanine based photosensitizers (Pcs) are among the most promising candidates for photodynamic therapy (PDT) due to their favorable photophysical and photochemical properties. An ideal photosensitizer should exhibit strong absorption (600–800 nm), where tissue penetration of light is optimal. Phthalocyanines meet this criterion through their intense Q band absorption, usually around 670–700 nm. Moreover, they are capable of efficiently generating singlet oxygen ($\Phi\Delta$), a key cytotoxic agent in PDT. In addition to their photodynamic efficiency, phthalocyanines demonstrate excellent chemical and photostability.

Preliminary research was conducted for photosensitizer properties of the compound. After researches, the results have showed that singlet oxygen quantum yield has increased in the photodynamic study ($\Phi\Delta=0.19$) compare to the Std-SiPc ($\Phi\Delta= 0.15$)

Keywords: Silicon phthalocyanine, Synthesis, Singlet oxygen, Electronic properties, Aggregation.

1 INTRODUCTION

Phthalocyanines (Pcs) which is aromatic macrocyclic compounds in coordination chemistry have high conjugation. Pcs consist of a 16-membered (8 carbon, 8 nitrogen) planar macrocycle with an 18- π electron system. The most important factor affecting the solubility of phthalocyanines is the strong π interactions between phthalocyanine molecules. As the π -stacking is prevented, the solubility of phthalocyanines in different solvents is increased. By adding axial ligands to the central metal atom (Si, Al, Ge, Ti, Sn, etc.), the solubility can be increased by reducing the π interaction between molecules.

Due to the electronic delocalization of phthalocyanines, they have been found to be useful for many applications in different fields. It is well known by scientists that phthalocyanines have been investigated in a wide range. These compounds research or usage areas can be listed as catalysts [1-2], electrochromics [3], photovoltaics [4-5], non-linear optics [6-7], dyes [8], antioxidants [9-10], antifungals [11], antibacterials [12], photosensitizers, sonosensitizers for photodynamic therapy [13-15], liquid crystals [16], gas sensors [17], thermal stabilities [18] or metal ion sensors [19-20]. Cancer is a disease that has been increasing worldwide recently and is being treated in different combinations [21]. Photodynamic therapy (PDT), which is an alternative treatment method to chemotherapy and radiotherapy, which are traditional methods used in the fight against this disease, is attracting attention [22]. PDT is based on the irradiation of the photosensitizer (PS) compound with light in the presence of oxygen. Phthalocyanines are complexes with high absorption coefficients in the 600-800 nm region [23]. The light used in PDT is usually in the range of 650-850 nm, which allow light to pass through human tissues. After light irradiation, energy is transferred from the photosensitizer to elemental oxygen and singlet oxygen is produced. After this production, singlet oxygen damages the DNA of cancer cells and can cause cell death [24-25]. The use of low-energy light and few side effects makes PDT more advantageous than other cancer treatment methods [26]. This treatment offers the patient comfort and deeper tissue penetration. For these purposes, it is aimed to synthesize new phthalocyanines and to reveal the photosensitizer potential of the synthesized compound.

In this study, a new bis(9-phenyl-9H-xanthen-9-oxy) phthalocyaninato silicon (IV) compound was synthesized and characterized. Additionally, the spectroscopic and photochemical properties of the phthalocyanine complex were investigated to determine their potential as photosensitizer in photodynamic therapy.

2 MATERIAL AND METHOD

Chloroform (CHCl_3), tetrahydrofuran (THF), dimethylformamide (DMF), and dimethyl sulfoxide (DMSO) were purchased from Sigma-Aldrich. SiPcCl_2 and 9-phenyl-9H-xanthen-9-ol were supplied by Alfa Aesar. Potassium carbonate (K_2CO_3), methanol, dichloromethane (CH_2Cl_2), and toluene were supplied by Merck and Acros Organics respectively. For structure characterization of UV visible spectra a Hitachi U-2900 Spectrophotometer was used. A Thermo Scientific FT-IR spectrometer was used to determine the vibration bands. NMR spectra were determined with an Agilent 400 MHz NMR spectrometer. Mass analysis of the compound was performed using an LC-MS electrospray.

2.1 Synthesis

Bis(9-phenyl-9H-xanthen-9-oxy) phthalocyaninato silicon (IV) (1)

SiPcCl_2 (75 mg, 0.12 mmol), 9-phenyl-9H-xanthen-9-ol (132 mg, 0.48 mmol) and K_2CO_3 (55 mg, 1.43 mmol) were mixed in dry toluene (10 mL) and refluxed for 24 h. Then the mixture has cooled to room temperature, the organic phase was separated by extraction (chloroform: water). After evaporation of solvent, the product was obtained. The product was dissolved in THF. Purification steps included by washing with ethanol and methanol. After this step, the product was dissolved in CH_2Cl_2 and filtered again. Finally, CH_2Cl_2 solutes were taken. m.p. > 300°C. Yield: 33 mg (25 %), FTIR (ATR), ν/cm^{-1} : 3053 (Ar-H), 1602 (C=N), 1571-1479 (Ar-C=C), 1450, 1315 (C-N), 1265, 1246-1151 (Ar-O-Ar), 1099-1070 (Si-O-C), 1033, 894, 871, 732, 704, 628. ^1H NMR (400MHz, DMSO-d_6), (δ): 7.35, 7.34, 7.31, 7.27, 7.24, 7.13, 7.09, 6.76. UV-Vis (CH_2Cl_2 , 1×10^{-5} M): $\lambda_{\text{max}}/\text{nm}$ (log ϵ): 675 (5.17), 350 (4.86). MS (ESI), (m/z): Calculated for $\text{C}_{70}\text{H}_{42}\text{N}_8\text{O}_4\text{Si}$: 1086.3; Found: 1087 $[\text{M}+\text{H}]^+$.

3 RESULTS AND DISCUSSION

The synthesis method of phthalocyanine **1** is given in Figure1. This compound is soluble in tetrahydrofuran, chloroform, dichloromethane, N,N-dimethylformamide, dimethyl sulphoxide. After the synthesis of the phthalocyanine, purification processes were carried out. Then the characterization process was started. In the IR spectrum of phthalocyanine **1** was observed aromatic vibrations at 3086 cm^{-1} , C=N peak was observed at 1602, the C=C peaks peak was observed at $1571\text{-}1479\text{ cm}^{-1}$, C-N peak was observed at 1315, Ar-O-Ar bond

vibrations was observed at 1246-1151, Si-O-C stretch peak was observed at 1099-1070 cm^{-1} which was supported data in the literature [27].

In the ESI mass spectrometry given ion peak at 1087 $[\text{M}+\text{H}]^+$ which was the expected.

In the ^1H NMR spectrum of compound **1**, aromatic protons were located at in the range of 7.35-6.76 ppm support the structure.

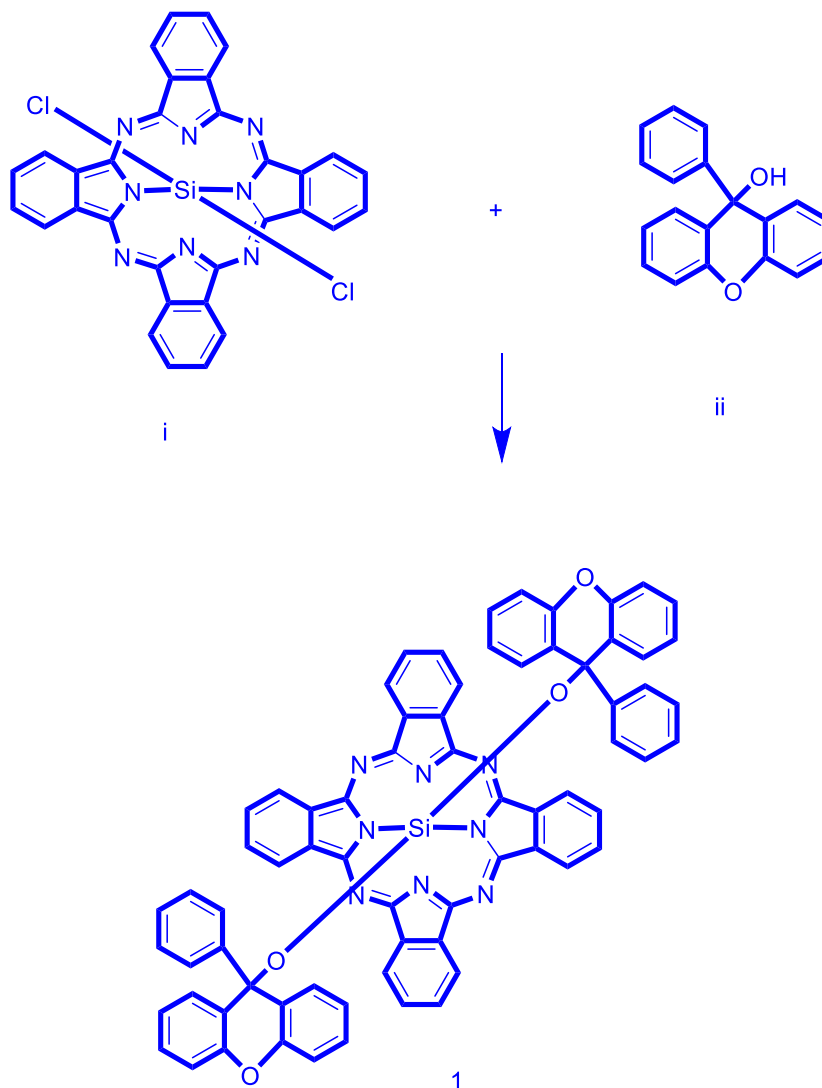


Figure 1. Synthesis scheme of compound 1.

The absorbance values saw in the UV-visible spectrum of the phthalocyanine complex are the Q band at 675 nm and the B band at 350 nm. These values are consistent with the absorbance values expected for the phthalocyanine structure. Electronic measurements of the compound in the range of 1.4×10^{-5} - 0.2×10^{-6} M show that the compound is not aggregated (Figure 2). These observed values show that the compound meets the prerequisite for use as a photosensitizer. If further studies support this parameter, the compound can be used as a photosensitizer.

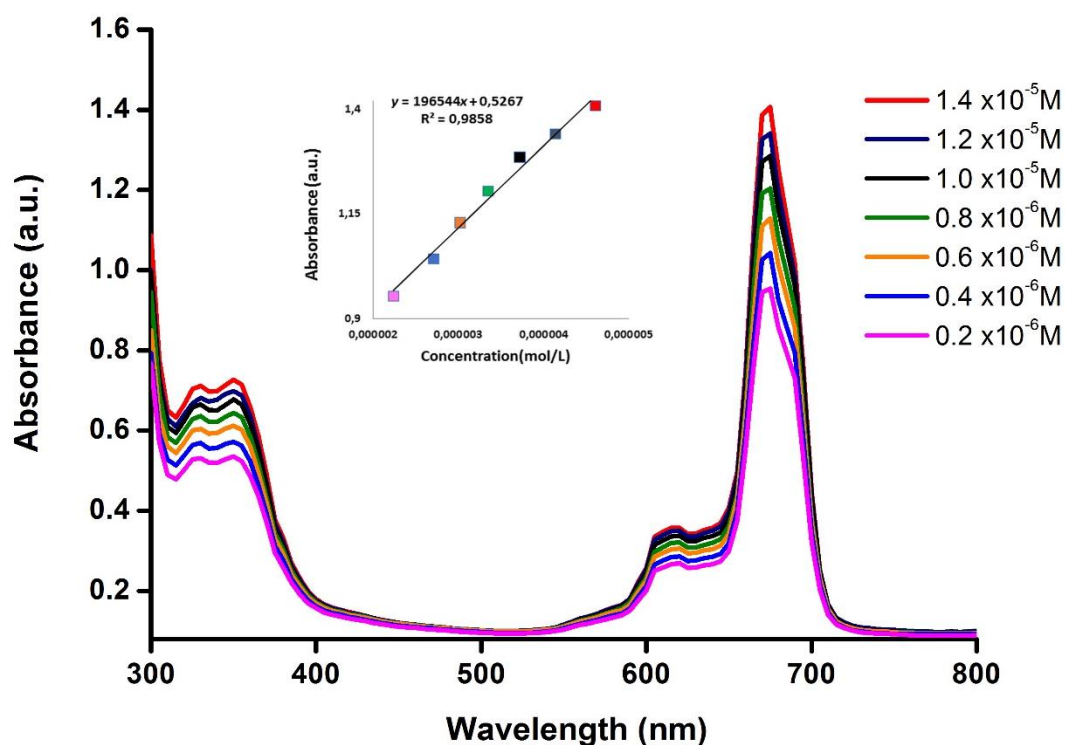


Figure 2. Absorption spectra of compound 1 in CH_2Cl_2 at 1.4×10^{-5} - 0.2×10^{-6} M concentrations.

The electronic absorption of compound 1 in tetrahydrofuran, chloroform, dichloromethane, N,N-dimethylformamide, dimethyl sulphoxide is shown in Figure 3. This compound is easily dissolved this solvents.

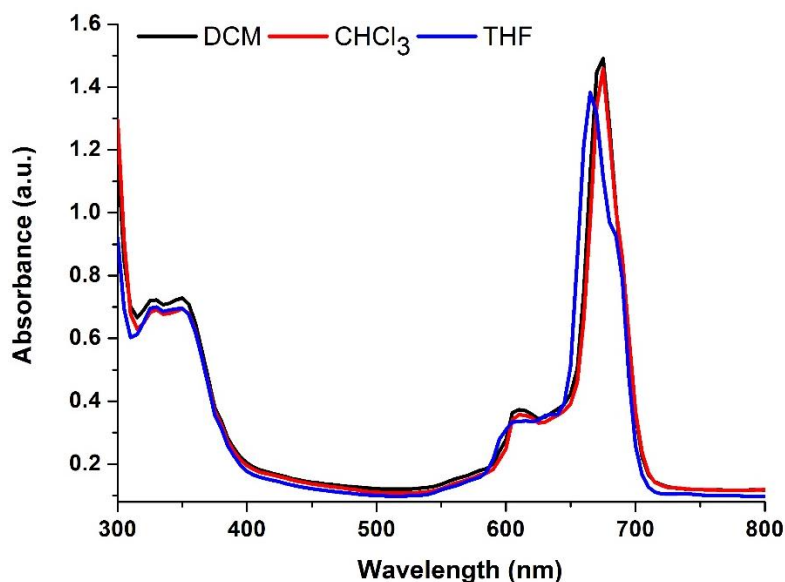


Figure 3. Absorption spectra of compound 1 in dichloromethane, chloroform and tetrahydrofuran solvents.

Phthalocyanines are interesting with their singlet oxygen production capacity. A quality sensitizer should have a great singlet oxygen efficiency. The light used in this study was provided by a 150 volt lamp. The sample was then exposed to light passed through an optical filter with a wavelength range of 650-720 nm, and placed in the cuvette. The singlet oxygen quantum yield of compound **1** was measured at 417 nm. DPBF was dissolved in DMSO under dark conditions, and the sample was subsequently irradiated within the Q band absorption region. The degradation of DPBF at 417 nm was monitored after each 5 s illuminate. While the Q bands of **1** did not alter, DPBF absorbance was decreased (Figure 4). Compound **1** has a high value ($\Phi_{\Delta}=0.19$) than Std-SiPc ($\Phi_{\Delta}=0.15$) [28].

Singlet oxygen quantum yield (Φ_{Δ}), a critical parameter in evaluating a photosensitizer's efficiency in photodynamic therapy, is typically calculated using a relative method with a standard reference photosensitizer. The singlet oxygen quantum yield (Φ_{Δ}) of a photosensitizer was determined by a comparative method using a reference compound with a known Φ_{Δ} value. The Φ_{Δ} value was calculated according to the equation:

$$\Phi_{\Delta} = \Phi_{\Delta}^{\text{Std}} \times \frac{R}{R^{\text{Std}}} \times \frac{I_{\text{abs}}^{\text{Std}}}{I_{\text{abs}}} \quad (1)$$

Φ_{Δ} : Singlet oxygen quantum yield of the sample

$\Phi_{\Delta}^{\text{std}}$: Singlet oxygen quantum yield of the standard

R_{DPBF} : Photobleaching rate of the singlet oxygen quencher in the presence of the sample

$R_{\text{DPBF}}^{\text{Std}}$: Photobleaching rate in the presence of the standard

I_{abs} : Absorbance of the sample at the irradiation wavelength

$I_{\text{abs}}^{\text{std}}$: Absorbance of the standard at the irradiation wavelength

The good performance of the phthalocyanine compound in singlet oxygen production shows that it has an advantageous effect. It shows the potential to be used in photodynamic therapy with other supportive tests.

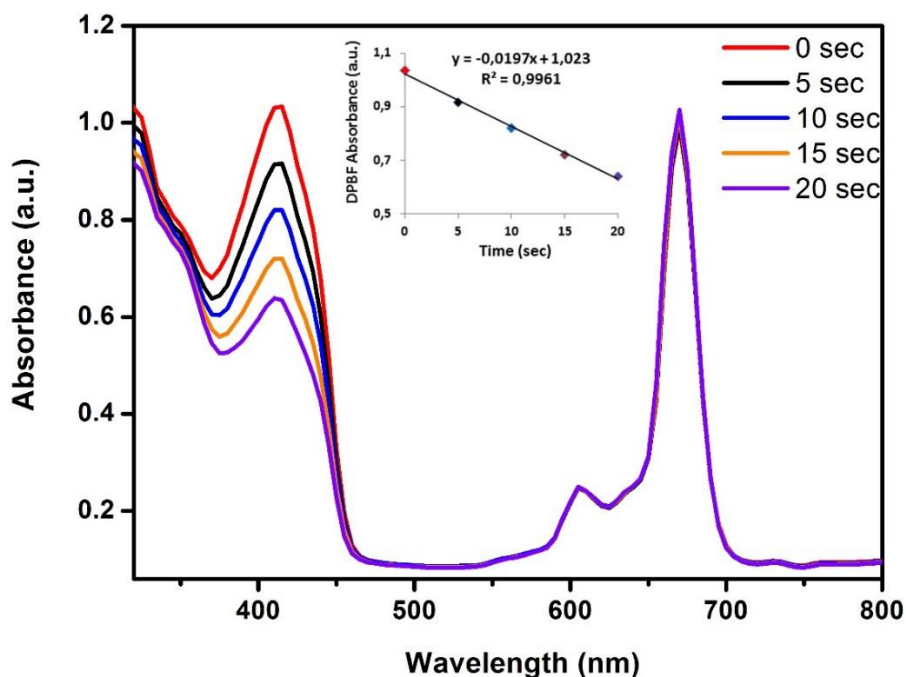


Figure 4. Measurement diagram of singlet oxygen quantum yield for compound 1.

4 CONCLUSION AND SUGGESTIONS

Bis(9-phenyl-9H-xanthen-9-oxy) phthalocyaninato silicon (IV) compound was originally synthesized. Compound **1** was characterized by ^1H NMR, UV-visible, FTIR, mass spectra. The electronic properties of bis(9-phenyl-9H-xanthen-9-oxy) phthalocyaninato silicon (IV) and its potential to produce singlet oxygen were investigated. Compound **1** show the potential to be used as a singlet oxygen generating agent for PDT.

This work has introduced a novel phthalocyanine derivative, bis(9-phenyl-9H-xanthen-9-oxy) phthalocyaninato silicon (IV), which was synthesized and characterized for the first time. The new axially disubstituted silicon(IV) phthalocyanine (Compound **1**) was confirmed by comprehensive spectroscopic analysis (^1H NMR, UV-Vis, FT-IR, and mass spectrometry). Basic electronics and photochemical properties of this compound were examined in detail, with particular focus on its ability to generate singlet oxygen ($^1\text{O}_2$).

The results demonstrate that Compound **1** is a highly efficient singlet oxygen photosensitizer. The singlet oxygen quantum yield (Φ_Δ) of this new phthalocyanine was measured as 0.19 which is superior to that of a standard silicon phthalocyanine ($\Phi_\Delta = 0.15$). This enhanced $^1\text{O}_2$ generation capacity indicates a notable improvement over similar phthalocyanine compounds reported in the literature. Such performance underscores the compound's potential not only in photodynamic therapy but also in advanced multi-modal treatment approaches. In

addition to its high singlet oxygen production, the structural features of Compound 1 impart other advantages for biomedical application. The bulky 9-phenyl-9H-xanthen-9-ol ligands likely reduce π - π stacking interactions, thereby lowering the aggregation tendency and improving solubility. These traits are highly desirable for phthalocyanine-based photosensitizers in biological environments. In summary, this study not only introduces a new silicon phthalocyanine derivative to the literature, but also demonstrates its promise as an efficient singlet oxygen generator for photodynamic therapy.

Acknowledgements

I would like to express my sincere gratitude to Prof. Dr. Mehmet Salih Ağırtaş for his valuable support and guidance throughout this study.

Statement of Research and Publication Ethics

The study is complied with research and publication ethics.

Artificial Intelligence (AI) Contribution Statement

This manuscript was entirely written, edited, analyzed, and prepared without the assistance of any artificial intelligence (AI) tools. All content, including text, data analysis, and figures, was solely generated by the authors.

REFERENCES

- [1] Y. Qian , C. Xu , X. Zhang , and X. Sun, “S-doped rich-defect cobalt-based carbon catalyst derived from cobalt phthalocyanine as catalysts of peroxymonosulfate for degradation of tetracycline hydrochloride from water,” *Journal of Environmental Chemical Engineering*, vol. 12, pp.112557, 2024.
- [2] S. Wu, Y. Duan, W. Kuang, W. Dong, X. Cui, X. Zhang, and Qian Duan, “Homogeneous catalysis and heterogeneous recovery: Thermo-responsive copolymer visible light catalyst with phthalocyanine as side groups,” *Reactive and Functional Polymers*, vol. 197, pp. 105857, 2024.
- [3] P. Şen, F. Dumludağ, B. Salih, A. R. Özkaya, and Ö. Bekaroğlu, “Synthesis and electrochemical, electrochromic and electrical properties of novel s-triazine bridged trinuclear Zn(II), Cu(II) and Lu(III) and a tris double-decker Lu(III) phthalocyanines,” *Synthetic Metals*, vol.161, pp. 1245-1254, 2011.
- [4] D. G. Solğun, U. Yildiko, and M. S. Ağırtaş, “Synthesis of bis-(benzhydryloxy) substituted axially silicon(IV) phthalocyanine: investigation of photophysical, photochemical, and computational electronic properties,” *Phosphorus, Sulfur, and Silicon and the Related Elements*, vol. 199, pp. 324-336, 2024.
- [5] Ö. Ödemiş, M. S. Ağırtaş, D. G. Solğun, and A. Özkartal, “Effect of silver nanoparticles prepared by green chemistry on the photovoltaic properties of zinc phthalocyanine,” *Chemical Papers*, vol. 78, pp. 3735–3746, 2024.
- [6] D. Gounden, N. Nombona, and W.E. van Zyl, “Recent advances in phthalocyanines for chemical sensor, non-linear optics (NLO) and energy storage applications,” *Coordination Chemistry Reviews*, vol. 420, pp. 213359, 2020.

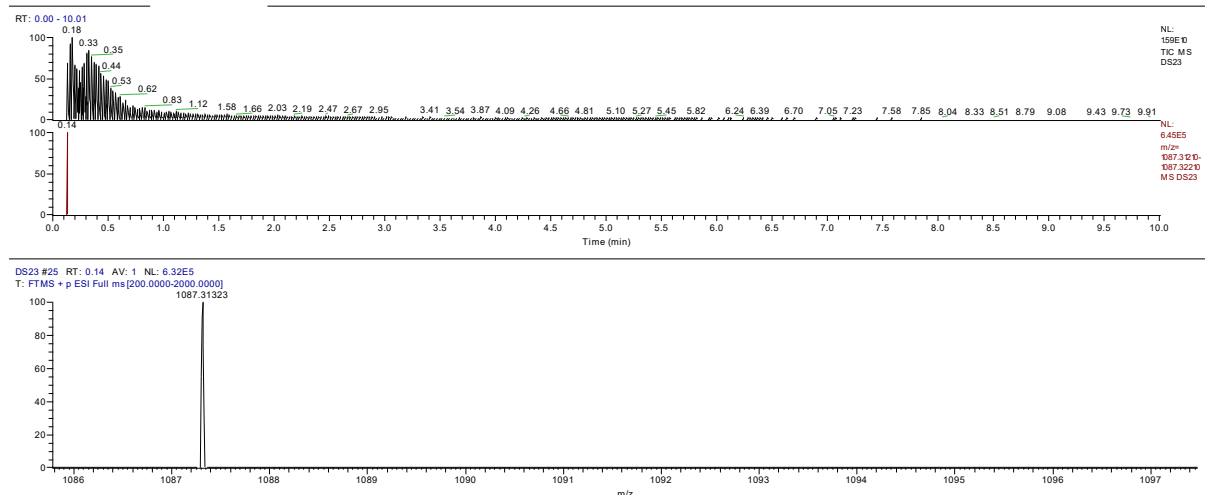
- [7] D. G. Solğun, Y. Gündoğdu, H. Ş Kılıç and M. S. Ağırtaş, "Synthesis of novel 2-(benzhydryloxy) phenoxy-substituted zinc phthalocyanine, third-order nonlinear optical and fluorescence properties," *Bulletin of Materials Science*, vol. 45, pp. 235, 2022.
- [8] S. A. Aal, and D. Awadh, "The effect of anchoring group on the performances of metal-free phthalocyanine and metallophthalocyanine dye/titanium dioxide interface for dye-sensitized solar cells," *Surfaces and Interfaces*, vol. 32, pp. 102089, 2022.
- [9] M. S. Ağırtaş, B. Cabir, and S. Özdemir, "Novel metal (II) phthalocyanines with 3,4,5-trimethoxybenzyloxy-substituents: Synthesis, characterization, aggregation behaviour and antioxidant activity," *Dyes and Pigments*, vol. 96, pp. 152-157, 2013.
- [10] G. P. Amaral, G. O. Puntel, C. L. D. Corte, F. Dobrachinski, R. P. Barcelos, L. L. Bastos, D. S. Ávila, J. B. T. Rocha, E. O. Silva, R. L. Puntel, and F. A. A. Soares, "The antioxidant properties of different phthalocyanines," *Toxicology in Vitro*, vol. 26, pp. 125-132, 2012.
- [11] X. S. Li, J. Guo, J. J. Zhuang, B. Y. Zheng, M. R. Ke, and J. D. Huang, "Highly positive-charged zinc(II) phthalocyanine as non-aggregated and efficient antifungal photosensitizer," *Bioorganic & Medicinal Chemistry Letters*, vol. 25, pp. 2386-2389, 2015.
- [12] M. Wysocki, D. Ziental, M. Jozkowiak, J. Długaszewska, H. P. Kempisty, E. Güzel, and L. Sobotta, "Porphyrazine/phthalocyanine hybrid complexes – Antibacterial and anticancer photodynamic and sonodynamic activity," *Synthetic Metals*, vol. 299, pp. 117474, 2023.
- [13] K. Hirakawa, A. Katayama, S. Yamaoka, T. Ikeue, and S. Okazaki, "Photosensitized protein damage by water-soluble phthalocyanine zinc(II) and gallium(III) complexes through electron transfer and singlet oxygen production," *Chemical Physics Letters*, vol. 802, pp. 139764, 2022.
- [14] X. Xing, S. Zhao, T. Xu, L. Huang, Y. Zhang, M. Lan, C. Lin, X. Zheng, and P. Wang, "Advances and perspectives in organic sonosensitizers for sonodynamic therapy," *Coordination Chemistry Reviews*, vol. 445, pp. 214087, 2021.
- [15] L. C. Nene, and H. Abrahamse, "Design consideration of phthalocyanines as sensitizers for enhanced sono-photodynamic combinatorial therapy of cancer," *Acta Pharmaceutica Sinica B*, vol. 14, pp. 1077-1097, 2024.
- [16] S. H. Choi, J. A. Kim, G. S. Heo, and H. G. Park, "Electro-optical characteristics of polymer-dispersed liquid crystal containing copper (II) phthalocyanine as a function of UV irradiation time," *Journal of Molecular Liquids*, vol. 363, pp. 119821, 2021.
- [17] M. S. Ağırtaş, A. Altındal, B. Salih, S. Saydam, and Ö. Bekaroğlu, "Synthesis, characterization, and electrochemical and electrical properties of novel mono and ball-type metallophthalocyanines with four 9,9-bis(4-hydroxyphenyl)fluorene," *Dalton Transactions*, vol. 40, pp. 3315-3324, 2011.
- [18] M. S. Ağırtaş, D. G. Solğun, S. Özdemir, and M. S. İzgi, "Synthesis of tetra 3,4-dimethoxyphenethoxy peripheral substituted metallophthalocyanines and investigation of some properties," *Chemistry Select*, vol. 3, pp. 3523–3528, 2018.
- [19] D. G. Solğun, and M. S. Ağırtaş, "Synthesis of novel an axially substituted silicon phthalocyanine and determination of its selectivity for Fe³⁺," *Journal of Molecular Structure*, vol. 1286, pp. 135577, 2023.
- [20] X. Wang, G. Ma, W. Zhang, W. Zhao, G. Lian, S. Zhang, D. Zhang, and W. Liu, "Multifunctional phthalocyanine NIR sensor for fluorescent and colorimetric dual-imaging and removal of intracellular and environmental Cu²⁺," *Journal of Photochemistry & Photobiology, A: Chemistry*, vol. 449, pp. 115355, 2024.
- [21] A. Abd-El-Aziz, S. A. Ahmed, X. Zhang, N. Ma, and A. S. Abd-El-Aziz, "Macromolecules incorporating transition metals in the treatment and detection of cancer and infectious diseases: Progress over the last decade," *Coordination Chemistry Reviews*, vol. 510, pp. 215732, 2024.
- [22] L. C. Nene, and H. Abrahamse, "Design consideration of phthalocyanines as sensitizers for enhanced sono-photodynamic combinatorial therapy of cancer," *Acta Pharmaceutica Sinica B*, vol. 14, pp. 1077-1097, 2024.
- [23] M. S. Ağırtaş, and M. S. İzgi, "Synthesis and characterization of new metallophthalocyanines with four phenoxyacetamide units," *Journal of Molecular Structure*, vol. 927, pp. 126–128, 2009.
- [24] A. Nas, S. Fandaklı, H. Kantekin, A. Demirbas, and M. Durmus, "Novel organosoluble metal-free and metallophthalocyanines bearing triazole moieties: microwave assisted synthesis and

- determination of photophysical and photochemical properties,” *Dyes and Pigments*, vol. 95 pp.8-17, 2012.
- [25] S. Aydogdu, G. Y. Atmaca, A. Erdoğan, and A. Hatipoğlu, “Synthesis of a new Zn- phthalocyanine, photophysical, photochemical, and sono-photochemical properties and DFT studies,” *Polyhedron*, vol. 256, pp. 116989, 2024.
- [26] Ü. Demirbas, C. Göl, B. Barut, R. Bayrak, M. Durmus, H. Kantekin, and İ. Değirmencioglu, “Peripherally and non-peripherally tetra-benzothiazole substituted metal-free, zinc(II) and lead(II) phthalocyanines: synthesis, characterization, and investigation of photophysical and photochemical properties,” *Journal of Molecular Structure*, vol. 1130, pp. 677-687, 2017.
- [27] İ. Ömeroğlu, E.N. Kaya, M. Göksel, V. Kussovski, V. Mantareva, and M. Durmus, “Axially substituted silicon(IV) phthalocyanine and its quaternized derivative as photosensitizers towards tumor cells and bacterial pathogens,” *Bioorganic Medicinal Chemistry*, vol. 25, pp. 5415–5422, 2017.
- [28] S.Y. Al-Raqa, K. Khezami, E.N. Kaya, and M. Durmuş, “A novel water soluble axially substituted silicon(IV) phthalocyanine bearing quaternized 4-(4-pyridinyl)phenol groups: Synthesis, characterization, photophysical properties and BSA/DNA binding behavior,” *Polyhedron*, vol. 194, pp. 114937, 2021.

SUPPLEMENTARY MATERIALS

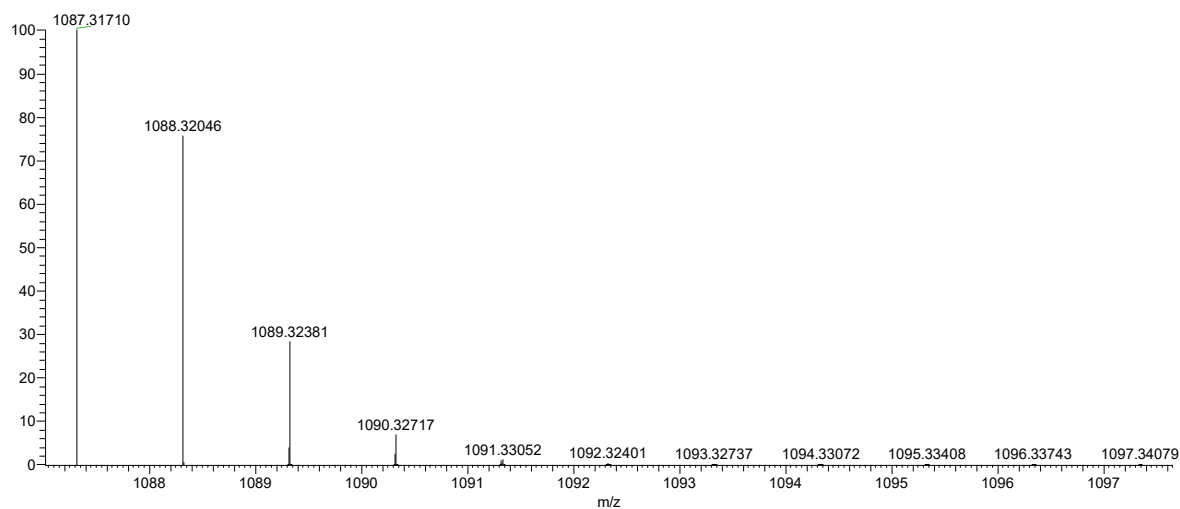
F:\2024-1432\DS23

02/08/24 16:22:36

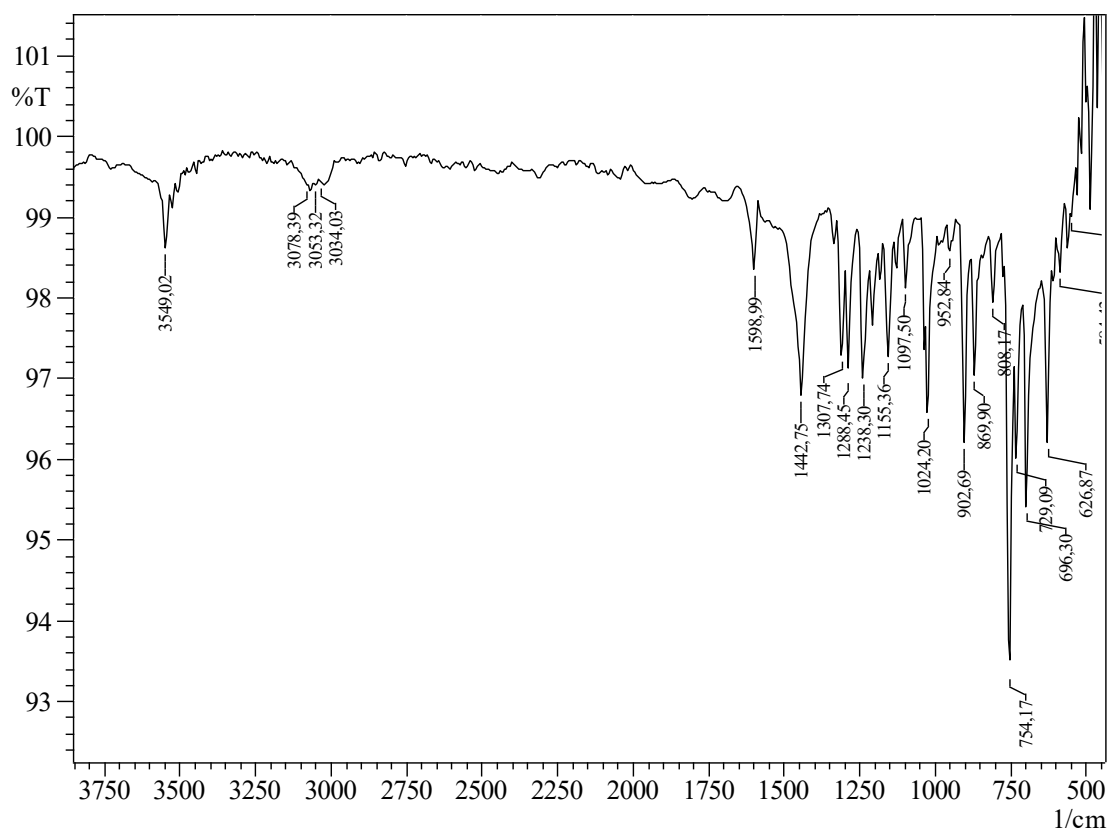


Appendix 1. HRMS (ESI) spectrum of $[M+H]^+$.

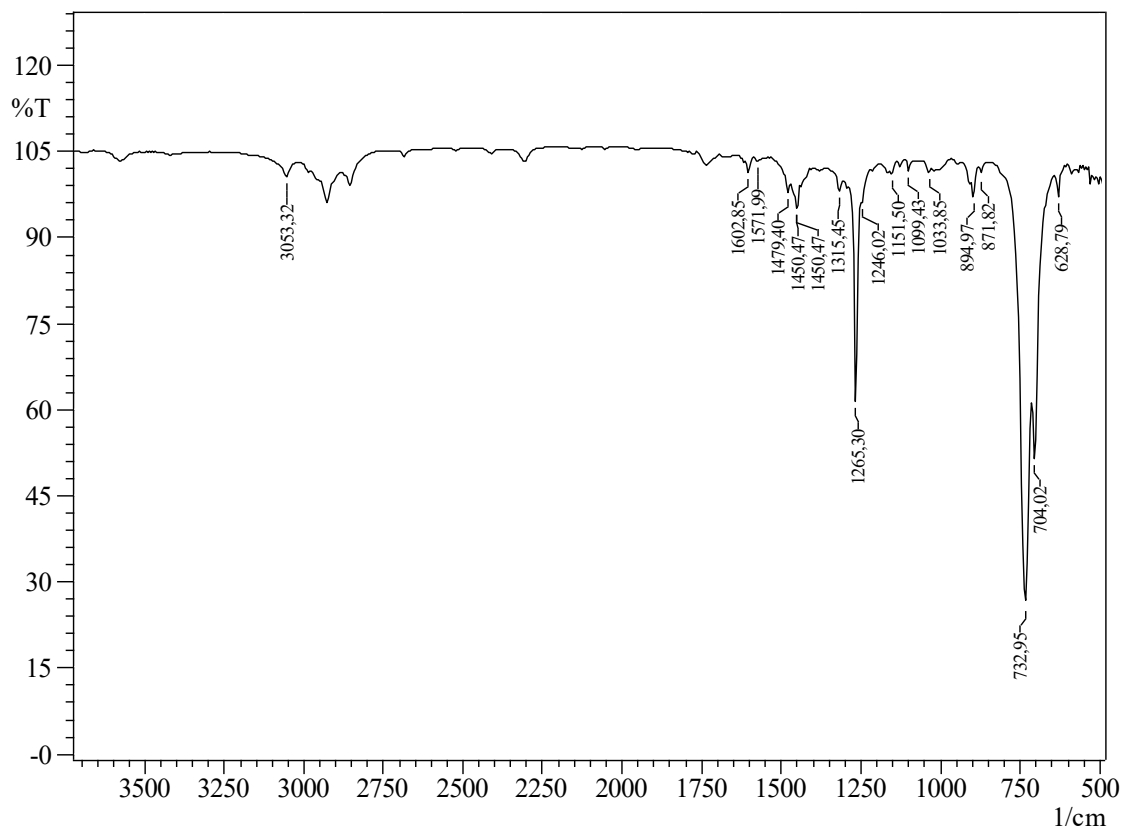
C70H42N8O4Si +H: C70 H43 N8 O4 Si1 pa Chrg 1



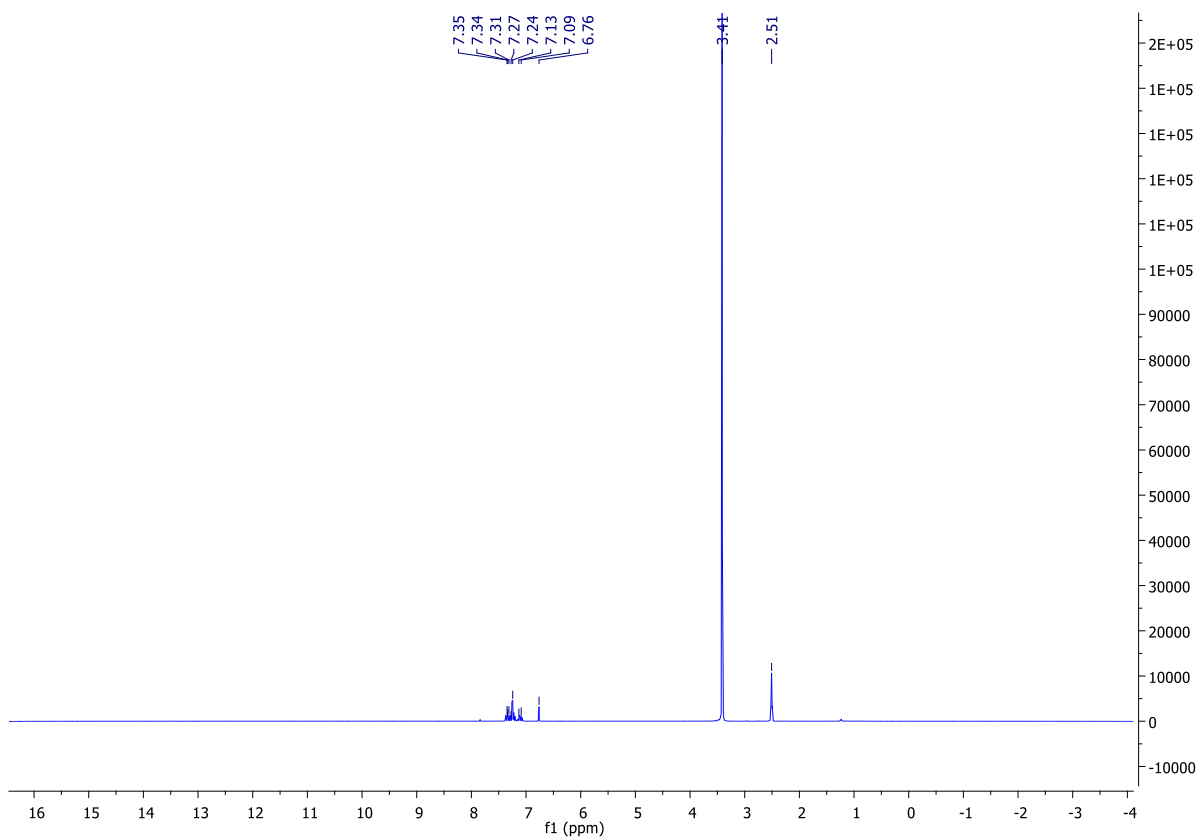
Appendix 2. HRMS (ESI) spectrum of compound 1 (Theoretical).



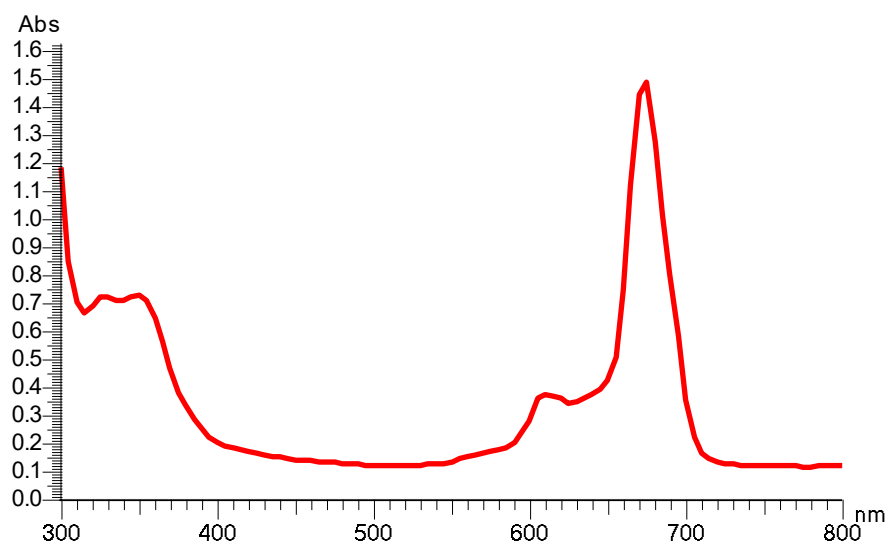
Appendix 3. FTIR spectrum of 9-phenylxanthen-9-ol.



Appendix 4. FTIR spectrum of compound 1.

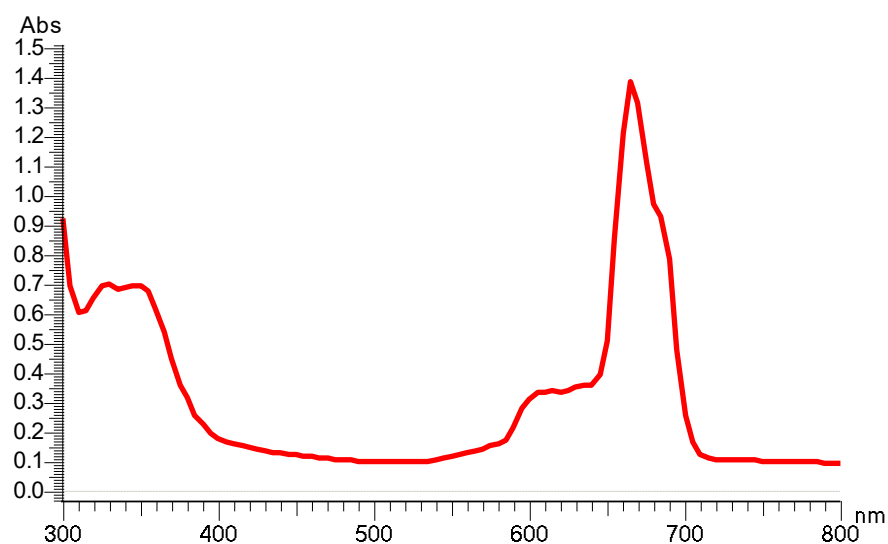


Appendix 5. ¹H NMR spectrum of compound 1.



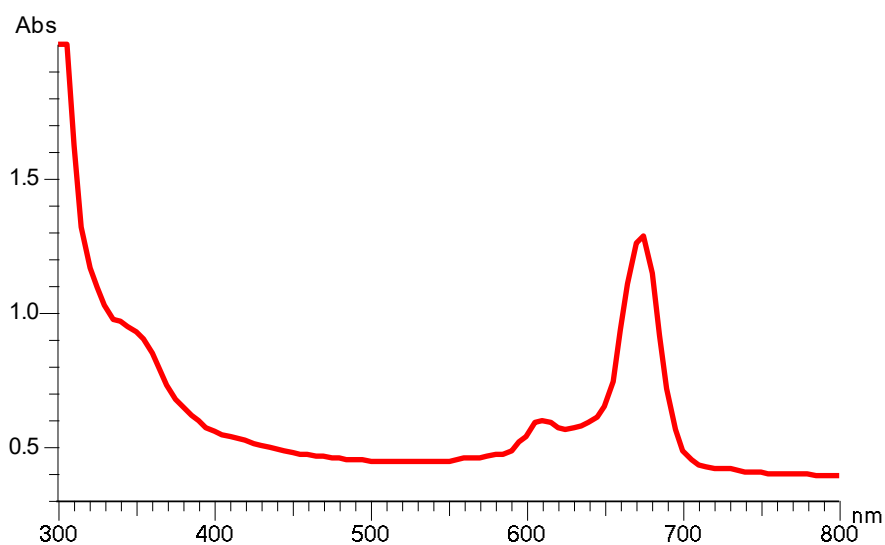
Peak #	Start (nm)	Apex (nm)	End (nm)	Height (Abs)	Valley (nm)	Valley (Abs)
1	800.0	675.0	515.0	1.490	515.0	0.121
2	515.0	350.0	300.0	0.729	300.0	1.186

Appendix 6. UV-Vis spectrum of compound 1 in THF.



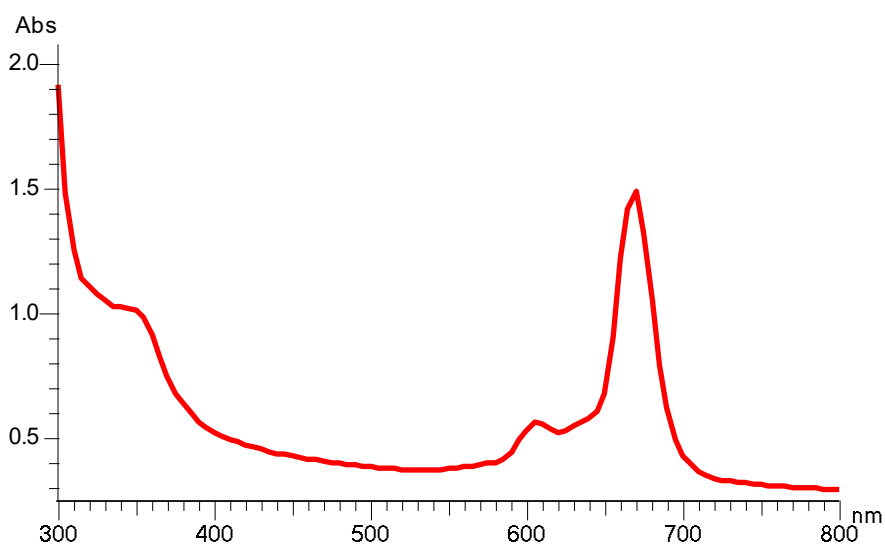
Peak #	Start (nm)	Apex (nm)	End (nm)	Height (Abs)	Valley (nm)	Valley (Abs)
1	800.0	665.0	515.0	1.383	515.0	0.098
2	515.0	330.0	300.0	0.700	300.0	0.921

Appendix 7. UV-Vis spectrum of compound 1 in DCM.



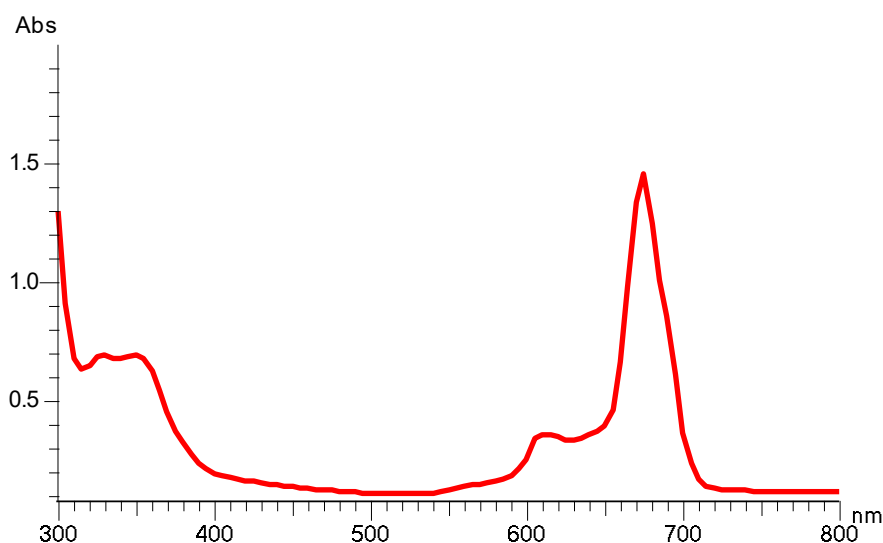
Peak #	Start (nm)	Apex (nm)	End (nm)	Height (Abs)	Valley (nm)	Valley (Abs)
1	800.0	675.0	530.0	1.286	530.0	0.443

Appendix 8. UV-Vis spectrum of compound 1 in DMSO.



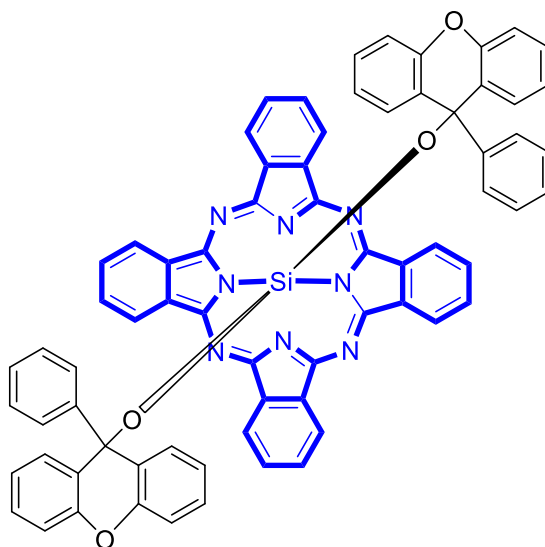
Peak #	Start (nm)	Apex (nm)	End (nm)	Height (Abs)	Valley (nm)	Valley (Abs)
1	800.0	670.0	535.0	1.491	535.0	0.370

Appendix 9. UV-Vis spectrum of compound 1 in DMF.



Peak #	Start (nm)	Apex (nm)	End (nm)	Height (Abs)	Valley (nm)	Valley (Abs)
1	800.0	675.0	520.0	1.458	520.0	0.107
2	520.0	350.0	300.0	0.694	300.0	1.294

Appendix 10. UV-Vis spectrum of compound 1 in CHCl_3 .



Chemical Formula: $\text{C}_{70}\text{H}_{42}\text{N}_8\text{O}_4\text{Si}$

Exact Mass: 1086,3

Molecular Weight: 1087,2

m/z: 1086.3 (100.0%), 1087.3 (75.7%), 1088.3 (28.3%), 1089.3 (6.1%), 1087.3 (5.1%), 1088.3 (3.8%), 1088.3 (3.3%), 1087.3 (3.0%), 1089.3 (2.5%), 1088.3 (2.2%), 1089.3 (1.4%), 1090.3 (1.3%)

Elemental Analysis: C, 77.33; H, 3.89; N, 10.31; O, 5.89; Si, 2.58

Appendix 11. Structural analysis data of compound 1.