

ELECTROCHEMICAL BEHAVIOUR OF PORPHYRINS AND THEIR METAL COMPLEXES

L. Bechki*, M. Kadri, A. Boutarfaia

University of Ouargla, VPRS Laboratory, PO Box 511, 30000, Ouargla, Algeria

Received: 21 February 2018 / Accepted: 17 July 2018 / Published online: 01 September 2018

ABSTRACT

This study aims to establish a group of heterogeneous organic compounds of porphyrin and derived compounds. This is useful for many medical fields such as phototherapy or industrial therapy such as dyes and OLED screens.

On this basis, we assembled a group of six compounds and a group of their compounds with different metals such as Zn and Co, and studied their properties by spectral methods. We conducted an electrochemical study through the voltmeter ring to study the effect of alternatives and the quality of the metal on the oxidation and for a group of six porphyrin compounds and enables us to study future applications of vehicles obtained and developed in OLED light emitting it.

Keywords: Porphyrin, complex; Hack and Suzuki; Non-covalent effects; corrosion; inhibitor.

Author Correspondence, e-mail: lbechki1@gmail.com

doi: <http://dx.doi.org/10.4314/jfas.v10i3.34>

1. INTRODUCTION

Electrochemistry studies chemical substance reactions occurring in a remedy at the user interface of the electron and/or ionic conductor through the use of an exterior potential difference over the interface and calculating the associated current response. On the other hand, the difference can be documented as a function of the applied current. A good example

of an electrochemical process is oxidation and/or reduced amount of an electroactive varieties at a good electrode. The electrochemical methods used in this paper include cyclic voltammetry, linear sweep voltammetry, amperometry and potentiometry [1].

In this publication the redox habit of porphyrins has been thoroughly investigated for their relevance to many biological procedures and lot of books reviews have been published in this field.

Metalloporphyrins containing flat iron and cobalt have been used as model chemical substances for hemoproteins and vitamin B12, nickel porphyrins have offered as models for coenzyme F430 while other metalloporphyrins have been used to study natural reactivity and function associations. A large number of metalloporphyrins have been looked into during previous three decades. Included in these are compounds with a huge selection of different porphyrin macrocycle, dozen of different coordinated axial ligands and near 80 metals ions [1].

The majority of metalloporphyrins electrochemistry entails either the central metallic ion other conjugated π system. Which means electrochemistry of metalloporphyrins can be explained from two factors of view: the type of central metallic ion and the type of macrocycle. However, electrochemistry of metalloporphyrins can be affected by the structural factors related to the quantity and kind of substituents mounted on the macrocycle or even to the amount of axial ligands destined to the central metallic ion [2].

Within the reviews released by Kadish [3], Felton [4], Davis [5], and Buchler [6] the authors talked about the electrochemistry of octaethylporphyrin (OEP) and tetraphenylporphyrin (TPP) derivatives. The chemical substances of the two series will always be used as comparison chemical substances against ideals of other recently synthesized metalloporphyrins.

Although lots of hydroporphyrin complexes have been synthesized [7], their poor yield, balance and purity highly limited the electrochemical and spectroscopic studies of the complexes. The electrochemical studies of some freebase [8] and iron hydroporphyrin complexes [9] have included the measurements of the redox potentials, and little information is on the facts of electron transfer.

On this basis, the voltmeter ring to study the effect of alternatives and the quality of the metal on the oxidation and For a group compounds and enable us to study future applications of vehicles obtained and developed in OLED light emitting it.

2. METHODS AND MATERIALS

All solvents were “Aldrich” grade unless otherwise stated. The following solvents were distilled prior to use (under argon): propionic acid; dichloromethane, aldehyde, pyrrole and MgSO_4 .

UV-Vis spectrophotometer (UV-2450, Shimadzu).

Analytical thin-layer chromatography (TLC) was performed on Merck Silica Gel 60 F254 TLC plates. Preparative column chromatography was performed on silica gel (40-63 μm) which was purchased from Qindao Haiyang Chemical Co. Ltd. China.

^1H , DQF COSY and NOESY NMR experiments were recorded on an Avance Bruker 400 spectrometer at 400.155 MHz. All samples were prepared in CDCl_3 , spectra were referenced to CHCl_3 at 7.26 ppm.

3. RESULTS AND DISCUSSION

3.1. Electrochemical study of compounds (A1, A2, A3)

The redox behaviour of A1, A2 and A3 was measured by cyclic voltammetry in dry CH_2Cl_2 using 0.1 M Bu_4NBF_4 as background electrolyte. The cyclic voltammogram (Figure 1) reveals redox processes associated with both the porphyrin. On the oxidation side of the CV a clear irreversible wave is observed at A1 ($\text{Ox}_1=1.03$ V) A2 ($\text{Ox}_1=0.53$ V , $\text{Ox}_2= 1.01$ V , $\text{Ox}_3= 1.36$ V) A3 ($\text{Ox}_1=0.74$ V , $\text{Ox}_2= 1.28$ V) On the reduction side of the CV a clear irreversible and quasi reversible wave is observed at A1 ($\text{Red}_1= -0.76$ V, $\text{Red}_2= -1.23$ V) A2 ($\text{Red}_1=-0.8$ V) A3 ($\text{Red}_1= -0.81$ V , $\text{Red}_2= -1.29$ V) Value difference $\Delta I \text{ Red}_1 - \text{Ox}_1$ I on the order were A1 = 2.27 V , A2 = 1.33 V , A3 = 1.56 V.

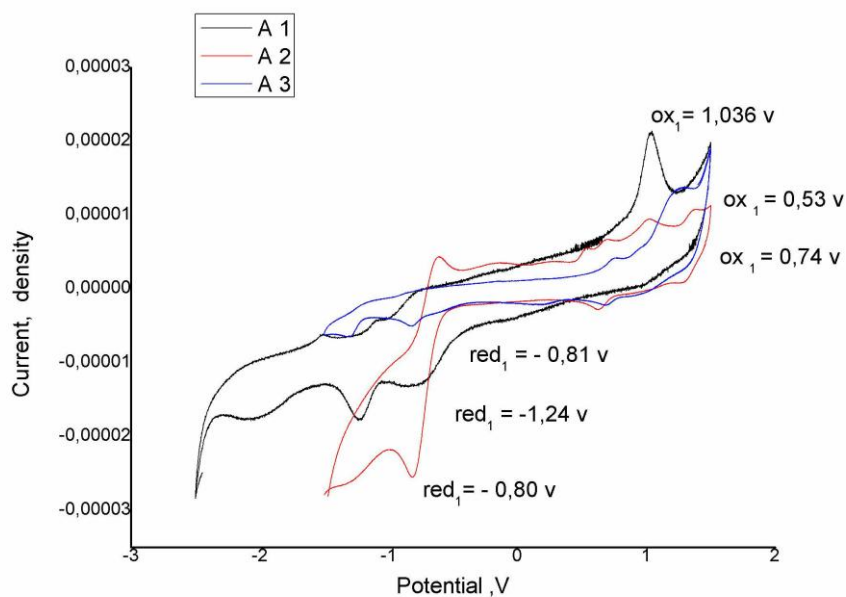
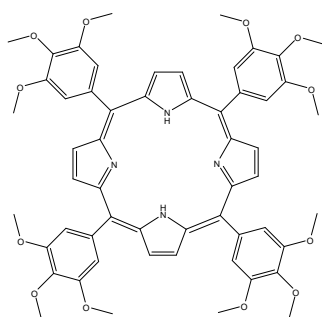
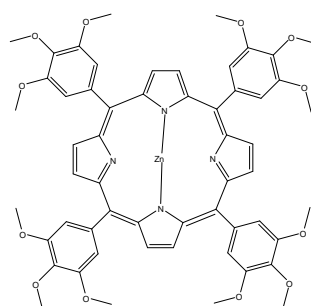


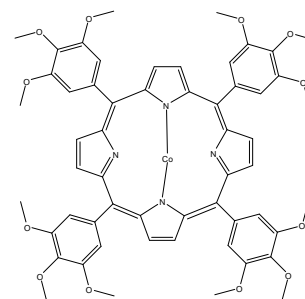
Fig.1. Cyclic voltammogram for (A1, A2, A3) in CH_2Cl_2 (0.1 M Bu_4NBF_4) at a glassy carbon working electrode, Scan rate = 100 mV s^{-1} .



A1



A2



A3

3.2. Electrochemical study of compounds (B1, B2, B3)

The redox behaviour of B1, B2, B3 was measured by cyclic voltammetry in dry CH_2Cl_2 using 0.1 M Bu_4NBF_4 as background electrolyte. The cyclic voltammogram (Figure 2) reveals redox processes associated with both the porphyrin. On the oxidation side of the CV a clear irreversible wave is observed at B1 ($\text{Ox}_1=1.23 \text{ V}$) B2 ($\text{Ox}_1=0.35 \text{ V}$, $\text{Ox}_2= 0.86 \text{ V}$) B3 ($\text{Ox}_1=0.73 \text{ V}$, $\text{Ox}_2= 0.98 \text{ V}$, $\text{Ox}_3= 1.2 \text{ V}$) On the reduction side of the CV a clear irreversible and quasi reversible wave is observed at B1 ($\text{Red}_1= -1.23 \text{ V}$) B2 ($\text{Red}_1= -0.85 \text{ V}$, $\text{Red}_2=$

-1.38 V) B3 (Red₁ = -0.86 V , Red₂ = -1.35 V).

Value difference ΔI Red₁ – Ox₁ I on the order were B1 = 2.46 V, B2 = 1.2 V, B3 = 1.59 V.

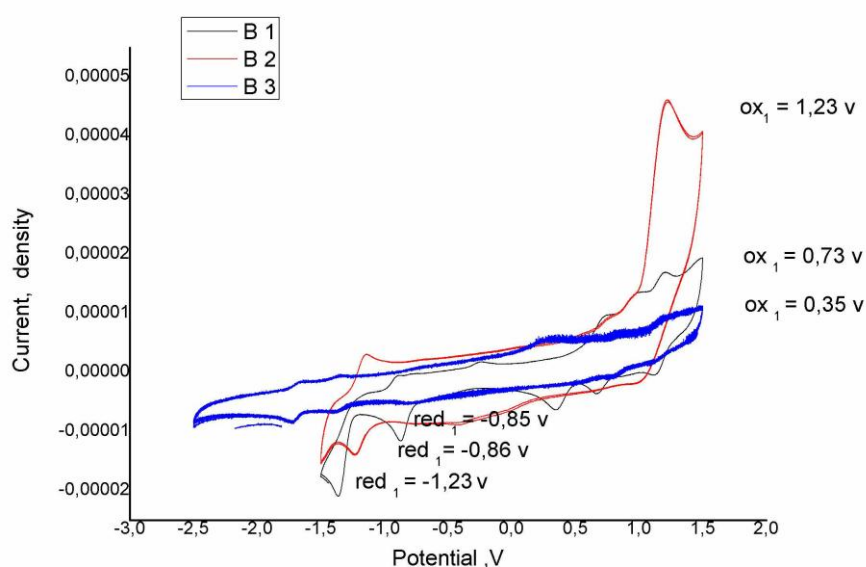
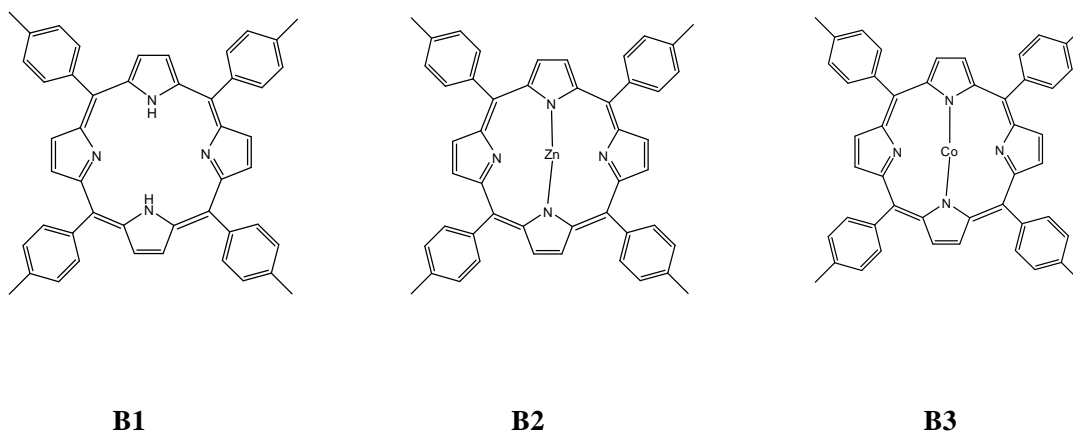


Fig.2. Cyclic voltammogram for (B1, B2 and B3) in CH₂Cl₂ (0.1 M Bu₄NBF₄) at a glassy carbon working electrode, Scan rate = 100 mV s⁻¹



4. CONCLUSION

We have studied electrophoresis by electrochemical through comparing a group of porphyrin to the effect of the tug, donor groups and the quality of the metal on the properties of oxidation and regression. The two-phase comparison was made between the compounds (B1, B2 and B3) (A1, A2 and A3) based on different metals. Based on different functional

substitutions in (A1, A2 and A3) the value of (RED 1 - OX 1) was in the following order 2.27, 1.33, 1.56 The difference between the first reaction and the first oxidation decreases in the compound containing the zinc metal and then the cobalt, after that the compound without metal.

It can be concluded that in the case of the mesomeric group tug, the value of the difference between the oxidation and the first return of the compound, whether metal or non-metal, increases compared with the donor group.

5. REFERENCES

- [1]. R. H. Felton, "The Porphyrins", Ed. David Dolphin, Vol. 5, Academic Press, New York, 1978, p 53-115.
- [2]. D. G. David, "The Porphyrins", Ed. David Dolphin, Vol. 5, Academic Press, New York, 1978, p127-150.
- [3]. K. M Kadish, Progress in Inorganic Chemistry, 1986, vol 34, p 437-604.
- [4]. Kadish, K. M. Prog. Inorg. Chem. 1986, vol 34, p435-605.
- [5]. Felton, R. H. "The Porphyrins"; D. Dolphin Ed.; Academic Press, New York, 1978.
- [6]. Davis, D. G. "The Porphyrins"; D. Dolphin Ed.; Academic Press, New York, 1978.
- [7]. Buchler, J. W.; Kokisch, W.; Smith, P. D. Struct. Bonding 1978, 34, 79.
- [8]. Buchler, J. W.; Porphyrins and Metalloporphyrins"; Smith, K. M. Ed.; Elsevier, New York, 1975.
- [9]. Flits, W. Adv. Heterocyclic Chem. 1988, 43, 73; Scheer, H. "The Porphyrins" Ed. By Dolphin, D. Vol. 2, Chapter 1, Academic Press, New York, 1978.

How to cite this article:

Bechki L, Kadri M, Boutarfaia A. Electrochemical studies of porphyrin and its metal complexes. J. Fundam. Appl. Sci., 2018, 10(3), 525-530.