SYNTHESIS AND CHARACTERIZATION OF TRANSITION METAL COMPLEXES AS POTENTIAL MATERIAL FOR DYE SENSITIZED SOLAR CELL

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILLMENT FOR THE AWARD OF MASTER OF SCIENCE (M.Sc) DEGREE IN INDUSTRIAL CHEMISTRY IN THE DEPARTMENT OF CHEMISTRY, COLLEGE OF SCIENCE AND TECHNOLOGY, COVENANT UNIVERSITY, OTA, OGUN STATE.

OCTOBER, 2020

ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfillment of the requirements for the award of the degree of Master of Science in Industrial Chemistry in the Department of Chemistry, College of Science and Technology, Covenant University, Ota.

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Prof. Abiodun H. Adebayo .....

Dean, School of Postgraduate Studies **Signature and Date**

DECLARATION

I, **NLEBEMUO, TOCHUKWU MARTINS (12CC014252)** declare that this research work was carried out by me under the supervision of Prof. Kehinde O. Ogunniran of the Department of Chemistry, Covenant University, Ota, Nigeria. I attest that this Dissertation has not been presented either wholly or partially for the award of any degree elsewhere. All sources of data, scholarly information used in this dissertation are duly acknowledged.

NLEBEMUO TOCHUKWU MARTINS ……

Signature & Date

CERTIFICATION

We certify that this Dissertation title **"SYNTHESIS AND CHARACTERISATION OF TRANSISTION METAL COMPLEXES AS POTENTIAL MATERIAL FOR DYE SENSITIZED SOLAR CELL"** is an original research carried out by **NLEBEMUO, TOCHUKWU MARTINS (12CC014252)** in the Department of Chemistry, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria, under the supervision of Prof. Kehinde O. Ogunniran. We have examined and found the work acceptable as part of the requirements for the award of Master of Science (M.Sc) in Industrial Chemistry.

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(Dean, School of Postgraduate Studies) **Signature and Date**

DEDICATION

This work is dedicated to God the Father, the Son and the Holy Spirit.

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ABSTRACT

Novel dye sensitizer materials in Dye-sensitized solar cell need to be found to meet the demand for cleaner energy. This study explores the potential of new metal complexes as possible dye sensitizers. The metal complexes were successfully synthesized using wet chemistry method. The ligands were prepared using 2,4 Dinitrophenyl hydrazine to react with salicylaldehyde, 2-thiophenecarboxaldehyde and 3-pyridinecarboxaldehyde separately in ratio (1:1). The three ligands formed were then reacted with three different metal salts each namely manganese acetate, zinc chloride and strontium chloride in ratio (3:1). The physico-chemical properties were gotten by calculation and observation. Selected synthesized compounds (both ligands and metal complexes) were characterized with spectroscopic techniques. The UV-visible spectroscopy of **Mn (H_1L)**, **Mn (H_2L)** and **Mn (H_3L)** showed maximum absorption wavelengths at 386 nm, 380 nm and 377 nm respectively. The FT-IR spectroscopy for selected compounds showed peaks around 3631.08 cm^{-1}, 1614.14 cm^{-1}, 1513.63 cm^{-1} and 913.13 cm^{-1} for O-H of alcohol, C=N of hydrazone, N-O of nitro and metal-ligand bond respectively. The ^{1}H-NMR spectroscopy for selected compounds showed signals between 7.05 ppm-8.50 ppm which suggests that the compounds have aromatic systems. Furthermore, structural and morphological studies were carried out on **Mn (H_1L)** and **Mn (H_2L)** using techniques such as TGA, XRD, SEM and TEM. The thermograph for **Mn (H_1L)** and **Mn (H_2L)** showed a loss of water molecules between 100 ^oC -120 ^oC, there was a gradual loss of the ligands between 120 ^oC-650 ^oC and finally a total loss of the ligand between 650 ^oC-800 ^oC leaving only the metal. The diffractograms of **Mn (H_1L)** and **Mn (H_2L)** showed sharp and intense peaks indicating fine crystalline rhombohedral phase as all peaks were well matched with database in JCPDS (file number: 77-1858). The degree of crystallinity for **Mn (H_1L)** was calculated from the diffractogram to be 89.7% while that of **Mn (H_2L)** was calculated to be 32.0%. The SEM photographs of **Mn (H_1L)** and **Mn (H_2L)** showed that **Mn (H_1L)** crystal-like morphology at the surface agreeing with the high degree of crystallinity from the diffractogram, while **Mn (H_2L)** had an irregular surface morphology. The TEM photograph of **Mn (H_1L)** showed the crystal-like nature within the material. The band gap energy for **Mn (H_1L), Mn (H_2L)** and **Mn (H_3L)** was estimated with DRS to be 2.47 eV, 2.48 eV and 2.33 eV respectively.

Keywords: Transition metal complexes, Dye sensitized solar cell, X-ray diffraction analysis, diffuse reflectance spectroscopy.