A Novel Approach for the Synthesis of *N*-based Heterocyclic Compounds and their Electrochemical Studies

Thesis submitted in partial fulfillment for the

Award of Degree

Doctor of Philosophy

By

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I, "**Neetu Verma"**, certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of "**Dr. Manisha Malviya"** from "**July-2018"** to "**October-2023**," at the **Department of Chemistry**, **Indian Institute of Technology, (BHU), Varanasi**. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not wilfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, theses, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

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It is certified that the above statement made by the student is correct to the best of my/our knowledge.

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Date: 08/12/2023

Place: Varanasi **(Neetu Verma)**

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θ	Angle (degree)
CV	Cyclic Voltammetry
CP	Chronopotentiometry
EIS	Electron Impedance spectroscopy
^{13}C NMR	Carbon nuclear magnetic resonance
eV	Electron volt
C_{dl}	Double layer capacitance
HRMS	High Resolution mass spectroscopy
µF	Microfarad
^{1}H NMR	Hydrogen nuclear magnetic resonance
µA	Microampere
TEMPO	(2,2,6,6-Tetramethylpiperidin-1-yl)oxidanyl
J	Coupling constant
°C	Degree celcius
$CDCl_3$	Deuterated chloroform
s	Second
DMSO-d_6	Deuterated Dimethyl sulfoxide
OCP	Open Circuit Potential
GCE	Glassy Carbon Electrode
CA	Chronoamperometry
CPE	Carbon Paste electrode

General Experimental Considerations

All the chemicals were procured from Aldrich, USA, and E. Merck, Germany, and werused as received. The solvents (DMF and DCM) were purchased from Merck and Ranbaxy and were purified before their use. The preparation and particulars of the substrates employed for the work undertaken are given in their respective chapters. Melting Points were measured using Stuart Melting point apparatus SPM10 in open capillary tubes. Electrochemical study were carried out on CHI 680C workstation. The ^{1}H (500MHz) and ^{13}C (126MHz) NMR, ^{19}F (126 MHz) NMR spectra were run on a Bruker Advance 500 MHz FT-NMR at 500 MHz spectrometers. Chemical shifts are given in δ ppm, using tetramethylsilane (TMS) as an internal standard HRMS (m/z) and were recorded in an electron ionization or electrospray ionization (ESI) mode on Waters- Q-TOF Premier- HAB213 and Sciex X500R QTOF instruments. **Purification** standard operating procedures for the specific solvent being purified, as different solvents may require different purification methods drying agents like (molecular sieves), inert gas purging. Additionally, it's essential to use high-purity glassware and equipment to avoid contamination during the purification process. **Thin-layer Chromatography (TLC)** was performed on glass plates (7.5 × 2.5 and 7.5 ×5.0 cm) coated with Merck silica gel 254 using various combinations of ethyl acetate and n-hexane as an eluent. Visualization of spots was accomplished either in an iodine chamber or by exposure to UV light. Merck silica gel (100-200 mesh) was used for column chromatography (approximately 15-20 g per 1 g of the crude product).