Dedicated to

My Beloved Parents
&
Brother

KEYWORDS

Polymer immobilization, Merrifield resin, Chitosan, Water-soluble polymer, Peroxidoniobium(V) compounds, Heterogeneous catalysts, Homogeneous catalyst, Olefin epoxidation, Phenol hydroxylation, Sulfoxidation, Organic-solvent-free reactions, 5-Hydroxymethyl-2-furancarboxylic acid (HMFCA), 5-Hydroxymethylfurfural (HMF) oxidation, Maltol, Deferiprone, Tris(maltolato)oxidoniobium(V), Acid Phosphatase Inhibition, Kinetics Study.

Declaration

I hereby declare that the thesis entitled "***Synthesis and Characterization of Homo- and Heteroleptic Niobium(V) Complexes. Exploration of Their Catalytic and Biochemical Potential***" being submitted to the Department of Chemical Sciences, Tezpur University, is a record of original research work carried out by me. Any text, figures, results or designs that are not of own devising are appropriately referenced in order to give credit to the original author(s). All sources of assistance have been assigned due acknowledgement. I also declare that neither this work as a whole nor a part of it has been submitted to any other university or institute for any other degree, diploma or award.

Place: Tezpur (Hiya Talukdar)

Date: 5.01.2024

TEZPUR UNIVERSITY
(A Central University Established by an Act of Parliament)
NAPAAM, TEZPUR-784028
DISTRICT: SONITPUR :: ASSAM :: INDIA

Ph: 03712-267004
03712-267005
Fax: 03712-267006
03712-267005

CERTIFICATE FROM SUPERVISOR

I certify that the thesis entitled "***Synthesis and Characterization of Homo- and Heteroleptic Niobium(V) Complexes. Exploration of Their Catalytic and Biochemical Potential***" submitted to the Tezpur University in the Department of Chemical Sciences under the School of Sciences, in partial fulfillment for the award of the degree of Doctor of Philosophy in Chemical Sciences is a record of research work carried out by Miss Hiya Talukdar under my supervision and guidance. All help received by her from various sources have been duly acknowledged. No part of this thesis has been submitted elsewhere for award of any other degree.

N. S. Islam

Place: Tezpur University
Date: 5.01.2024

(Prof. Nashreen S. Islam)
Professor
Department of Chemical Sciences
School of Sciences

TEZPUR UNIVERSITY

(A central university by an act of Parliament)

DISTRICT: SONITPUR :: ASSAM:: INDIA

Napaam, Tezpur-784028

Fax: 03712-267006 Ph: 03712-267004 ***Email:*** ***adm@agnigarh.tezu.ernet.in***

CERTIFICATE OF THE EXTERNAL EXAMINER AND ODEC

This is to certify that the thesis entitled "***Synthesis and Characterization of Homo- and Heteroleptic Niobium(V) Complexes. Exploration of Their Catalytic and Biochemical Potential***" submitted by Hiya Talukdar to Tezpur University in the Department of Chemical Sciences under the School of Sciences in partial fulfilment of the requirement for the award of the degree of Doctor of Philosophy in Chemical Sciences has been examined by us on _____ and found to be satisfactory.

Signature of:

Principal Supervisor External Examiner

Date:_____

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Hiya Talukdar

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LIST OF ABBREVIATIONS

NMRI	Nuclear magnetic resonance imaging
MRI	Magnetic resonance imaging
PON	Polyoxoniobate
CFI	Complement factor I
Hb	Hemoglobin
KNN	$K_{0.5}Na_{0.5}NbO_3$
MCF	Mesocellular foam
SBA	Santa Barbara Amorphous
MCM-41	Mobil Composition of Matter No. 41
MOF	Metal organic framework
Cp	Cyclopentadiene
thd	2-[3-[(4-Amino-2-methyl-5-pyrimidinyl)methyl]-2-(1,2-dihydroxyethyl)-4-methyl-1,3-thiazol-3-ium-5-yl]ethyl trihydrogen diphosphate
acac	Acetylacetonato
silox	Siloxide
dmpe	1,2-Bis(dimethylphosphino)ethane
PPP	Phosphinophenylphosphine
pV	Peroxidovanadium
pNb	Peroxidoniobium
TpNb	$[Nb(O_2)_4]^{3-}$
gu	Guanidinium
DTPA	Diethylenetriaminepentaacetic acid
EDTA	Ethylenediaminetetraacetic acid
hq	Hydroxyquinolinate
quin-2-c	Quinoline-2-carboxylate ion
ox	Oxalate
tart	Tartaric acid
glyc	Glycollate
Hmal	Malic acid
Asc	Ascorbate anion

Httha	Triethylenetetraminehexaacetic acid
pdta	Propanediaminetetraacetate
pic	Picolinic acid
dipic	Pyridine-2,6-dicarboxylic acid
bpy	2,2'-Bipyridine
phen	Phenanthroline
pzdc	Pyrazine-2,3-dicarboxylate
FFA	Free fatty acid
IL	Ionic liquid
CE	Crown ether
TBA/LA	Tetrabutylammonium/lactate
NPs	Nanoparticles
TPPTS	P(*m*-$C_6H_4SO_3Na)_3$
MR	Merrifield resin
PS-DVB	Polystyrene divinylbenzene copolymer
CSDVB	Cross-linked poly(styrene-divinylbenzene)
PPESK	Poly(phthalazinone ether sulfone ketone)
PA	Poly(sodium acrylate)
PMMA	Poly(methylmethacrylate)
PS-BBP	Polystyrene functionalized with 2,6-bis(benzimidazolyl)pyridine
POP	Porous organic polymer
TPA	Triphenyl amine
PAN	Polyacrylonitrile
PEI	Polyethyleneimine
PAAc	Polyacrylic acid
P4VP	Poly(4-vinyl pyridine)
PEG	Polyethyleneglycol
P-HPHZ	Polymer anchored N,N'-bis (o-hydroxy acetophenone) hydrazine
PS-naph	Amino polystyrene anchored azo ligand
PNB	Polynorbornene
c-PMA_n	Cross-linked poly(methyl acrylate)

PAACA	Poly(acrylic acid-co-acrylamide)
PS-An	Chloromethylated polystyrene functionalized with anthranilic acid
HCPs	Hyper-cross-linked polymers
COP	Covalent organic polymer
DIOP	4,5-bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxidolane
NHC	*N*-heterocyclic carbene
PS	Polystyrene
WSP	Water-soluble polymer
EDX	Energy Dispersive X-Ray
AAS	Atomic absorption spectroscopy
ICP-OES	Inductively coupled plasma optical emission spectrophotometer
CHN	Carbon, hydrogen and nitrogen
SEM	Scanning Electron Microscope
PXRD	Powder X-ray diffraction
XPS	X-ray photoelectron spectroscopy
BET	Brunauer–Emmett–Teller
TGA	Thermogravimetric analysis
HPLC	High performance liquid chromatography
GC-MS	Gas chromatography-mass spectrometry
MPS	Methyl phenyl sulfide
RT	Room temperature
MRVNb	$[Nb(O_2)_3(val)]^{2-}$–MR [val = valine]
MRNNb	$[Nb(O_2)_3(asn)]^{2-}$–MR [asn = asparagine]
MRGNb	$[Nb(O_2)_3(gly)]^{2-}$–MR [gly = glycine]
Sty	Styrene
TLC	Thin layer chromatography
Calix	Calixarene
KIT	Korea Advanced Institute of Science and Technology
MMM	Mixed matrix membrane

CNTs	Carbon nano tubes
DMC	Dimethyl carbonate
NbPMA	$[Nb(O_2)_3(carboxylate)]^{2-}$–PMA [PMA = poly(sodium methacrylate
HMF	5-Hydroxymethyl-2-furfural
HMFCA	5-Hydroxymethyl-2-furancarboxylic acid
wt.	Weight
ChpNb	$[Nb(O_2)_3(NH_2)(OH)]^-$-chitosan
PH	Phenol
RB	Round-bottomed flask
TpTa	$[Nb(O_2)_4]^{3-}$
BJH	Barrett-Joyner-Halenda
eq.	Equivalent
LD_{50}	Lethal dose, 50%
malt	Maltol
def	Deferiprone
EC_{50}	Half maximal effective concentration
ACP	Acid phosphatase
ALP	Alkaline phosphatase
p-NPP	*p*-nitrophenyl phosphate
IC_{50}	Half maximal inhibitory concentration
GST-PTP1B	Glutathione S-transferase-tagged protein tyrosine phosphatase 1B
PTPase	Protein tyrosine phosphatase