Dedicated

to

My Beloved

Maa-Deta

Dada-Bou

& Rig

DECLARATION BY THE CANDIDATE

I, **Ms. Julie Baruah**, Ph.D. Scholar (**Regd no.:TZ189844 of 2018**), Department of Chemical Sciences, Tezpur University, hereby, declare that the thesis entitled, **"An Integrated Approach for Generation of Hydroxymethylfurfural Platform Chemical from Renewable Lignocellulosic Sources"** has been submitted to the **Department of Chemical Sciences, Tezpur University** under the School of Sciences in partial fulfilment for the award of the degree of Doctor of Philosophy in Chemical Sciences. This is an original work carried out by me and it has not been previously considered for the award of any degree, diploma, associateship, fellowship or any other similar title or recognition from any University, Institute, or other organization.

I further declare that; I have duly acknowledged the support received from respective sources.

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This is to certify that the thesis entitled "***An Integrated Approach for Generation of Hydroxymethylfurfural Platform Chemical from Renewable Lignocellulosic Sources***" submitted by **Ms. Julie Baruah** to the School of Sciences, Tezpur University in partial fulfilment for the award of the degree of Doctor of Philosophy in **Chemical Sciences** is a record of bonafide research work carried out by her under my supervision and guidance. She has been duly registered, completed her Ph.D. course work and the thesis presented is worthy of consideration for the award of Ph.D. degree.

All help received by her from various sources have been duly acknowledged.

The contents of this thesis, in full or in part, have not been submitted to any other university for the award of any degree or diploma.

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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.

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The committee recommends for the award of the Degree of Doctor of Philosophy.

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Julie Baruah

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LIST OF ABBREVIATIONS AND SYMBOLS

[AMIM]Cl	1-Allyl-3-methylimidazolium chloride
[EMIM]BF_4	1-ethyl-3-methylimidazolium tetrafluoroborate
[EMIM]Br	1-ethyl-3-methylimidazolium bromide
[EMIM]Cl	1-ethyl-3-methylimidazolium chloride
3-DG	3-Deoxyglucosone
AARE	Absolute average relative error
Adj R^2	Adjusted R^2
AFEX	Ammonia fiber explosion
AlPO	Aluminium phosphate
AN	Aniline
ANFIS	Adaptive neuro-fuzzy inference system
ANN	Artificial neural network
ANOVA	Analysis of variance
APS	Ammonium persulfate
ARE	Average relative error
B3LYP	Becke, 3-parameter, Lee–Yang–Parr
BET	Brunauer-Emmett-Teller
BJH	Barrett-Joyner-Halenda
BTU	British thermal units
BuOH	n-Butanol
$C_2H_2O_4$	Oxalic acid
$C_2H_4O_2$	Acetic acid
$C_6H_8O_7$	Citric acid
CCD	Central composite design
CePO	Cerium phosphate
ChCl	Cholin chloride
ChOAc	Choline acetate
CrI	Crystallinity index
CSA	Carbon-based solid acid
DES	Deep eutectic solvents
DFT	Density functional theory

DMA	Dimethylacetamide
DMF	Dimethylformamide
DMSO	Dimethyl sulfoxide
DP	Degree of polymerization
DTG	Derivative thermogram
EDX	Energy Dispersive X-ray Diffraction spectroscopy
emu	Unit for magnetic moment
eV	Electronvolt
FDCA	2,5-Furandicarboxylic acid
Fe_3O_4	Magnetite/ Iron (II, III) oxide
$FeCl_3.6H_2O$	Ferric chloride
$FeCl_4.H_2O$	Ferrous chloride tetrahydrate
FePO	Iron phosphate
FPU	Filter paper unit
FTIR	Fourier transform infrared
g	Gram
GVL	γ-Velerolactone
h	Hour
$H_2N(CH_2)_6NH_2$	1,6-hexanediamine
H_2O_2	Hydrogen peroxide
H_2SO_4	Sulphuric acid
H_3PO_4	Orthophosphoric acid
HBD	Hydrogen bond donor
Hc	Negligible coercivity
HCl	Hydrochloric acid
HCW	Hot compressed water
HfPO	Hafnium phosphate
HMF	5-hydroxymethylfurfural
HNO_3	Nitric acid
HPA	Heteropoly acids
HPLC	High-performance liquid chromatography
HRTEM	High resolution transmission electron microscopy
HYBRID	Hybrid fractional error function

ICP-AES	Inductively coupled plasma atomic emission spectroscopy
ILs	Ionic liquids
IUPAC	International Union of Pure and Applied Chemistry
KBr	Potassium Bromide
LA	Levulinic acid
LCB	Lignocellulosic biomass
LHW	Liquid Hot Water
LiP	Lignin peroxidase
LM	Levenberg Marquardt
M	Molar
MA	Metanillic acid
MCSC	Macroporous carbonaceous solid catalysts
MF	Membership functions
mg	Milligram
MIBK	Methyl isobutyl ketone
min	Minute
mL	Millilitre
MLP	Multi-Layered- Perceptron
mMol	Millimole
MMT	Montmorillonite
MMT	Million metric tonnes
MnP	Manganese peroxidase
MnPO	Manganese phosphate
MPSED	Marquardt's percent standard error deviation
MPTMS	3-mercaptopropyltrimethoxysilane
M_r	Remanent magnetization
M_s	Saturation magnetization
$Na_3C_6H_5O_7$	Sodium citrate
NaOH	Sodium hydroxide
$NbCl_5$	Niobium pentachloride
NbO_2	Niobium dioxide
NbPO	Niobium phosphate
NH_3-TPD	Ammonia - Temperature programmed desorption

nm	Nanometre
NMMO	N-methylmorpholine-N-oxide
NMP	N-methyl pyrrolidone
OPMF	Oil palm mesocarp fiber
PANI	Polyaniline
R^2	Correlation coefficient
RMSE	Root mean squares error
rpm	Revolutions per minute
RSM	Response surface methodology
SAED	Selected area electron diffraction
SAXS	Small-angle X-ray scattering
SEM	Scanning electron microscope
SnPO	Tin phosphate
$-SO_3H$	Sulfonic acid groups
SPAN	Sulfonated polyaniline
SSB	Sweet sorghum bagasse
TAPPI	Technical Association of Pulp and Paper Industry
TEOS	Tetraethyl orthosilicate
TGA	Thermogravimetric Analysis
THF	Tetrahydrofuran
TiO_2	Titanium dioxide
TiPO	Titanium phosphate
UV-vis	Ultraviolet-Visible spectroscopy
VP	Versatile peroxidase
VP	Versatile peroxide
VPO	Vanadium phosphate
VSM	Vibrating Sample Magnetometer
XPS	X-ray photoelectron spectroscopy
XRD	X-ray Diffraction
ZrO_2	Zirconium dioxide
ZrPO	Zirconium phosphate
$\Delta_r G^\circ$	Gibbs free energy
$\Delta_r H^\circ$	Enthalpy