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Napaam-784028, Tezpur, Sonitpur, Assam, India

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### DECLARATION BY THE CANDIDATE

I, **Ms. Sangeeta Kalita**, hereby declare that the thesis entitled “**Study of Acidic Organic Salts in Catalysis and Nanomaterial Synthesis**” has been submitted to Tezpur University, Assam, in partial fulfilment of the requirements for the award of the degree of **Doctor of Philosophy in Chemical Sciences**, is a record of original research work carried out by me under the guidance of **Prof. Ruli Borah**, Department of Chemical Sciences, Tezpur University.

The contents of the thesis, in full or in part, have not been previously considered for the award of any degree, diploma, or any other similar title or recognition from any University/Institute. I further declare that I have duly acknowledged all sources of assistance and any text, figures, results or design that are not of my own are appropriately referenced in order to give credit to the original author(s).

**Date:** 30/06/2025

**Place:** Tezpur University

*Sangeeta Kalita*

(**Sangeeta Kalita**)



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(Awardee of Visitor's Best University Award, 2016 and 5<sup>th</sup> among India's Top 100 Universities, MHRD-NIRF Ranking, 2016)

Ruli Borah  
Professor  
Department of Chemical Sciences  
School of Sciences, Tezpur University

Email: ruli@tezu.ernet.in  
rulitezu@gmail.com  
Phone: 9435380377  
Fax: +91 3712 267005/6

### *Certificate from the Supervisor*

This is to certify that the thesis entitled “Study of Acidic Organic Salts in Catalysis and Nanomaterial Synthesis” submitted 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 research work carried out by **Ms. Sangeeta Kalita** under my supervision and guidance. She has been duly registered, completed her Ph.D. coursework and the thesis presented is worthy of consideration for the award of Ph.D. degree.

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

No part of this thesis has been submitted elsewhere for the award of any other degree or diploma.

Date: 30/06/2025

Place: Tezpur University

(Prof. Ruli Borah)



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***CERTIFICATE OF THE EXTERNAL EXAMINER AND ODEC***

This is to certify that the thesis entitled “**Study of Acidic Organic Salts in Catalysis and Nanomaterial Synthesis**” submitted by Ms. Sangeeta Kalita to Tezpur University in partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy in Chemical Sciences has been examined by us on ..... and found to be satisfactory.

The committee recommends **Ms. Sangeeta Kalita** for the award of the degree of **Doctor of Philosophy in Chemical Sciences**.

**Principal Supervisor**

**External Examiner**

**Date:**

**Date:**

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*Sangeeta Kalita*

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*List of Abbreviations*

ILs	Ionic liquids
RTILs	Room temperature ionic liquids
NPs	Nanoparticles
TSILs	Task-specific ionic liquids
DFT	Density functional theory
POMs	Polyoxometalates
IL-POMs	Polyoxometalate hybrids of ionic liquids
MDSIM	2-Methyl-1,3-disulfoimidazolium
DEDSA	N,N'-Diethyldisulfoammonium
DSPZ	1,4-Disulfopiperazinium
REMILs	Rare-earth metal ionic liquids
DSIL	Double salt ionic liquid
PET	Poly(ethylene terephthalate)
BHET	Bis(hydroxyethyl) terephthalate
amim	1-allyl-3-methylimidazolium
DMAP	4-(N,N-dimethylamino) pyridine
Hmim	1-methylimidazolium trifluoroacetate
bmim	1-Butyl-3-methylimidazolium
TBAP	Tetrabutylammonium permanganate
CTAP	Cetyltrimethylammonium permanganate
BTAP	Benzyltriethylammonium permanganate
MTBAP	Methyltributylammonium permanganate
DCM	Dichloromethane
CTAB	Cetyltrimethylammonium bromide
TBAB	Tetrabutylammonium bromide
DMSO	Dimethyl sulfoxide
HDS	Hydrodesulfurization
DBT	Dibenzothiophene
AOP	Advanced oxidation process
eV	Electron volt
MB	Methylene blue
MO	Methyl orange

CV	Crystal violet
UV	Ultraviolet
GO	Graphene oxide
FT-IR	Fourier Transform Infrared
NMR	Nuclear Magnetic Resonance
ppm	Parts per million
TGA	Thermo-gravimetric analysis
PXRD	Powder X-Ray Diffraction
SAED	Selected area electron diffraction
DRS	Diffuse Reflectance Spectroscopy
SEM	Scanning Electron Microscopy
EDX	Energy Dispersive X-Ray
TEM	Transmission Electron Microscopy
BET	Brunauer -Emmett-Teller
XPS	X-Ray Photoelectron Spectroscopy
HPLC	High-Performance Liquid Chromatography
GC-MS	Gas Chromatography-Mass Spectrometry
TLC	Thin layer chromatography
CH <sub>3</sub> CN	Acetonitrile
EtOAc	Ethyl acetate
H <sub>2</sub> SO <sub>4</sub>	Sulfuric acid
NaOH	Sodium hydroxide
TO	Transverse optical
LO	Longitudinal optical
VB	Valence band
CB	Conduction band
DMSO-d <sub>6</sub>	Deuterated dimethyl sulfoxide
CDCl <sub>3</sub>	Deuterated chloroform
UV-Vis	Ultraviolet-visible
OTf	Triflate
TFA	Trifluoroacetate
<sup>1</sup> H	Proton
<sup>13</sup> C	Carbon-13 isotope

JCPDS	Joint Committee on Powder Diffraction Standards
CHN	Carbon Hydrogen Nitrogen
i.e.	That is
J	Coupling Constant in NMR
s	Singlet in NMR
d	Doublet in NMR
t	Triplet in NMR
mg	Milligram
mL	Millilitre
mmol	Millimole
mol	Mole
M.p.	Melting Point
No.	Number
R.T.	Room temperature
h	Hour
min	Minute