Fluorinated Nanomaterials for Energy and Sensing Applications

A Thesis submitted by

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in partial fulfillment of the requirements for the award of the degree of

Doctor of Philosophy

Indian Institute of Technology Jodhpur
Department of Chemistry

May 2021

Declaration

I hereby declare that the work presented in this Thesis titled *Fluorinated Nanomaterials for Energy and Sensing Applications* submitted to the Indian Institute of Technology Jodhpur in partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy, is a bonafide record of the research work carried out under the supervision of Dr. Ritu Gupta. The contents of this thesis in full or in parts, have not been submitted to, and will not be submitted by me to, any other Institute or University in India or abroad for the award of any degree or diploma.

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Certificate

This is to certify that the thesis titled *Fluorinated Nanomaterials for Energy and Sensing Applications*, submitted by *Gaurav Bahuguna* (P16CY001) to the Indian Institute of Technology Jodhpur for the award of the degree of *Doctor of Philosophy*, is a bonafide record of the research work done by him under my supervision. To the best of my knowledge, the contents of this report, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

Ritu Gupta
Ph.D. Thesis Supervisor

Acknowledgements

I thank my Ph.D. Thesis Supervisor, *Professor Ritu Gupta* for her constant support during my journey at IIT Jodhpur. The amount of time and efforts that she has given in my Ph.D journey is thankless. It has been my pleasure learning under her guidance. She has been a constant source of inspiration which gave me enough strength to learn new things with each passing day in my Ph.D. There has been tremendous learning in the past few years under her guidance which will also carry forward in the future. Apart from my academic excellence, she has also taken care of my physical and mental well being by providing a homely environment at IIT Jodhpur.

I would like to thank Professor Rakesh K. Sharma for providing valuable guidance and support during Ph.D from time to time. His presence around has been a source of positivity and cheerfulness.

I thank Professor G. U. Kulkarni for giving me a chance to work under his esteemed guidance. It has been a great experience working in his lab. The enthusiasm and energy that he carries has been a constant source of motivation.

I extend my thanks to all my lab mates Ajay, Mohit, Anandita, Vinay, Vinod, Vipin, Akshay, Chesta, Savi, Hamid and Parijat for active collaborations, being helpful and exhibiting work ethics of highest level.

I thank Dr. Vikas Janu (Defence Lab Jodhpur, Jodhpur), Dr. Pura Ram (IIT Jodhpur), Dr. Saswata Bhatacharya and Manish Kumar (IIT Delhi) and Dr. Ashutosh, Dr. S. Angappane Dr. N. Kambhala and Indrajit (CeNS, Bangalore) for the collaborative work and helpful discussions.

I thank Dr. Pragati, Dr. Kiran, Dr. Poonam and Devika for providing a cordial and learning environment during the initial years of my Ph.D.

I thank all the faculty members, technical staff (Mr Ganpat and Mr Shubham), office staff of the Department of Chemistry (Miss Swati, Mr. Sandip), IIT Jodhpur for being supportive throughout this time.

I would like to thank all my friends who has always been with me through my ups and downs. I failed in some of my experiments but they never failed to bring back the smile on my face. The precious time spent with some of them in the campus of IIT Jodhpur and outside will always be missed and cherished. I will have to write another thesis to acknowledge each one of them with thousands of stories.

At the end I acknowledge my parents and family who has always been with me. That one minute phone call each day gave me hope for working next day with same enthusiasm. They have sacrificed a lot for me and has always been supportive in all the circumstances. I pay my highest level of respect to my family for their love, sacrifice and blessings.

I Wholeheartedly Dedicate the Thesis to My Family…

Gaurav Bahuguna
Ph.D. Student

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List of Symbols

Symbol	*Description*
I	Current
V	Voltage
C	Capacitance
t	Time
s	Second
T	Temperature
mL	Milliliter
μL	Microliter
A	Ampere
nA	Nano Ampere
F	Farad
M	Molar
C	Capacitance
A	Area
ε_r	Dielectric constant of electrolyte
°	Degree
I	Intensity
Ω	ohm
%	Percentage
θ	Theta
λ	Wavelength
ν	Frequency
Å	Angstrom
K	Kelvin
Oe	Oersted
H_C	Coercivity
M_s	Saturation Magnetization
mV	Millivolt

List of Abbreviations

Abbreviation	*Full form*
XRD	X-Ray Diffraction
XPS	X-ray Photoelectron Spectroscopy
UV	Ultra Violet
FTIR	Fourier Transform Infrared spectroscopy
BET	Brunauer-Emmett-Teller
SAED	Selected Area Electron Diffraction
TEM	Transmission Electronic Microscopy
HRTEM	High Resolution Transmission Electron Microscopy
SEM	Scanning Electronic Microscopy
XRD	X-ray Diffraction
EDX	Energy Dispersive X-ray Spectroscopy
RHE	Reference Hydrogen Electrode
PEC	Photoelectrochemical
ppm	Parts Per Million
JCPDS	Joint Commission on Powder Diffraction sheet
ICSD	Inorganic Crystal Structure Database
FTO	Fluorine Doped Tin Oxide
F-TEDA	Chloromethyl-4-fluoro-1,4-diazoniabicyclo[2.2.2]octane bis(tetrafluoroborate)
CC	Carbon Cloth
VC	Vulcan Carbon
F-VC	Fluorinated Vulcan Carbon
DI	Deionized water
EIS	Electrochemical Impedance Spectroscopy
CV	Cyclic Voltametry
IV	Current-Voltage
I-t	Current-time
GCD	Galvanostatic Charge discharge
VOC	Volatile organic Compound
PPC	Persistent Photoconductivity
LOD	Limit of detection
DC	Direct Current
Ace	Acetone
EtOH	Ethanol
MeOH	Methanol
tBuOH	t-butyl alcohol
PrOH	Iso-Propanol
MEK	butanone
Chl	Chloroform
AcOEt	Ethylacetate
Tol	Toluene
DCM	di-chloro methane
DMF	dimethyl formamide
Pentanal	Pentanal
ACN	Acetonitrile
Hexane	Hexane
TEA	Triethylamine
DEA	diethylamine

RT	Room Temperature
RH	Relative humidity