

*Dedicated to
My Family
and
Dear Friends*

DECLARATION BY THE CANDIDATE

I hereby declare that the thesis "*Synthesis and sensing attributes of semiconducting transition metal dichalcogenide nanostructures with special emphasis on WS₂, aided by exploitation of their antimicrobial activity*", being submitted to the **School of Sciences, Tezpur University**, Tezpur, Assam in partial fulfilment of the requirements for the award of the Doctor of Philosophy in Physics, is a record of original work carried out by me at **Department of Physics, Tezpur University**, Assam, under the supervision of **Dr. Rajib Biswas**, Assistant Professor, **Department of Physics, Tezpur University**. All sources of assistance have been duly acknowledged. I also declare that neither this work as a whole nor a part of it has been submitted to another university or institute for any degree, diploma, associateship, fellowship, or any other similar title or recognition.

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Date: 08/02/24 (revised thesis)

Registration No: **TZ201057 of 2019**

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CERTIFICATE OF THE SUPERVISOR

This is to certify that the thesis entitled “*Synthesis and sensing attributes of semiconducting transition metal dichalcogenide nanostructures with special emphasis on WS₂, aided by exploitation of their antimicrobial activity*”, submitted to the School of Sciences, Tezpur University, in partial fulfilment for the award of the Degree of Doctor of Philosophy in Physics is a record of research work carried out by Ms. Ashamoni Neog 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 or any other degree.

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CERTIFICATE OF THE EXTERNAL EXAMINER

This is to certify that the thesis entitled "**Synthesis and sensing attributes of semiconducting transition metal dichalcogenide nanostructures with special emphasis on WS₂, aided by exploitation of their antimicrobial activity**" submitted by **Ms. Ashamoni Neog** to Tezpur University in the Department of Physics under the School of Sciences in partial fulfilment of the requirement for the award of degree of Doctor of Philosophy in Physics has been examined by us on 19th March 2024 and found satisfactory.

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

Date:

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External Examiner

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(Knowledge is the eye of desire and can become the pilot of the soul. _Will Durant)

(Ashamoni Neog)

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LIST OF ABBREVIATIONS

TMDC	Transition metal dichalcogenides
WS ₂	Tungsten disulfide
MoS ₂	Molybdenum disulfide
NMP	N-methyl-2-pyrrolidone
IPA	Isopropyl alcohol
1D	One dimension
2D	Two dimension
3D	Three dimension
JCPDS	Joint Committee on Powder Diffraction Standards
XRD	X-ray Diffraction
FWHM	Full Width Half Maxima
SAED	Selective Area Electron Diffraction
HRTEM	High Resolution Transmission Electron Microscopy
SEM	Scanning Electron Microscopy
WHO	World Health Organization
HMI	Heavy metal ion
EPA	Environmental Protection Agency
LOD	Limit of detection
LOQ	Limit of quantification
As	Arsenic
Hg	Mercury
Cd	Cadmium
Ni	Nickel
Pb	Lead
Cu	Copper
Fe	Iron
Co	Cobalt
Zn	Zinc
Se	Selenium
Sn	Tin
DD	Double Distilled
Ar	Argon

Li	Lithium
PL	Photoluminescence
ZOI	Zone of Inhibition
MTCC	Microbial Type Culture Collection and Gene Bank
<i>MS</i>	<i>Mycobacterium smegmatis</i>
<i>SA</i>	<i>Staphylococcus aureus</i>
<i>BC</i>	<i>Bacillus cereus</i>
<i>PA</i>	<i>Pseudomonas aeruginosa</i>
<i>YP</i>	<i>Yersinia pestis</i>
<i>EC</i>	<i>Escherichia. coli</i>
<i>CA</i>	<i>Candida albicans</i>
G	Gentamicin
N	Nystatin
NG	no growth
NZ	no zone
Resistant	R
Intermediate	I
Susceptible	S
Not applicable	NA
<i>T</i>	Tetragonal
<i>H</i>	Hexagonal
<i>R</i>	Rhombohedral
<i>T'</i>	Monoclinic

LIST OF SYMBOLS

λ	wavelength
θ	Bragg's angle
λ_{exc}	excitation wavelength
σ	standard deviation
m	slope
S	Simens
nm	nanometer
mm	milimeter
cm	centimeter
μm	micrometer
μA	micro ampere
nA	nano ampere
V	volt
mL	mililitre
mg	mililitre
$^{\circ}\text{C}$	degree celsius
\AA	angstrom
C	conductance
f	frequency
a.u.	absorption unit
min	minute
mW	Miliwatt
eV	Electron Volt
$I-V$	Current-Voltage
$I-t$	Current-time
psi	pound per square inch
H	Hexagonal
h	Hour
Hz	Hertz
ppb	parts per billion
ppm	parts per million