



*Dedicated to my brother,*  
**Afzal**

## *DECLARATION BY THE CANDIDATE*

The thesis entitled "*Evaluation of europium doped gadolinium oxide and orthovanadate nanosystems and their biophysical relevance*" is being submitted to the Tezpur University in partial fulfilment for the award of the degree of Doctor of Philosophy in *Physics* is a record of bonafide research work accomplished by me under the supervision of Prof. D. Mohanta.

All helps received 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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### **CERTIFICATE OF THE PRINCIPAL SUPERVISOR**

This is to certify that the thesis entitled "*Evaluation of europium doped gadolinium oxide and orthovanadate nanosystems and their biophysical relevance*" 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 **Aftab Ansari** under my supervision and guidance.

All help received by him 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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## CERTIFICATE OF THE EXTERNAL EXAMINER AND ODEC

This is to certify that the thesis entitled "*Evaluation of europium doped gadolinium oxide and orthovanadate nanosystems and their biophysical relevance*" submitted by **Aftab Ansari** to Tezpur University in the Department of Physics under School of Sciences in partial fulfilment for the award of the degree of Doctor of Philosophy in Physics has been examined by us on \_\_\_\_\_ and found to be satisfactory.

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## Acknowledgement

I am extremely content for completing this thesis as an outcome of the past few years of my dedicated academic research work in fulfilling requirement for my Ph.D. As this Ph.D. journey approaches its completion, I would like to take the opportunity to thank the people closely involved in the work, without whom, realization of the thesis would be near impossible. To begin with, I thank my supervisor Prof. Dambarudhar Mohanta for his constant guidance and support throughout the work in all possible ways and manner. I am really grateful to be selected as a team member of Nanoscience and Soft Matter Laboratory under his guidance, to be able to learn

I would also like to express my sincere thanks to my DC members, (Late) Prof. A. Kumar, Prof. A. Ramteke and Dr. R. Biswas for their timely evaluation of the progresses made in the tenure. I am grateful to all the faculty members of Department of Physics, Tezpur University for extending help and valuable advice whenever asked for. I am thankful to the technical staff for their help and support whenever required. I appreciate departmental staff Narayan da and Patir da for their assistance in easing out the academic regulations.

I hereby acknowledge SAIC-TU for extending sophisticated instruments for conducting my experimental works. I acknowledge SAIF, NEHU, Shillong for extending ICP-OES instrumentation and SAIF, NEIST, Jorhat for their HRTEM and XPS facilities. I would like to offer sincere thanks to Prof. R. Doley, Department MBBT, TU, for support in conducting the bio-physical characterizations. I also thank Dr. Abhijit Saha, UGC-DAE CSR Consortium, Kolkata, for  $\gamma$ -irradiation and PL/TRPL as well as Raman measurements.

I acknowledge the constant care by my lab seniors- Samiran Da, Saurabh Da, Swati Ba, Amrita Ba, who have guided me as a younger brother. I also thank my lab juniors- Jimly, Mahesh, Ankush, Stuti, Kakoli and Sushmita for their support in all respects. I consider myself fortunate enough to have some wonderful friends:

(Department of Physics) KD, Ankur, Anki, Anshuman, Meenakshi, Mayuri, Debs, Hati, Sritam, and Pritam; Muzi, Panchhi and Monoj Da (Department of MBBT); Shilpa Ba and Anamika (Department of Environmental Science). I mention Sus and Rafik, specially, for being the support system through all highs and lows in the journey. I also extend my gratitude for their help and support to my friends away from other universities: Somashree Ba, Sudip Da, Nazrul, Rashmita. I am grateful to have friends who care, love, and support me unconditionally: Suki, Bhasky, Preeti, Pius and specially Krishnaaa!

I also take the opportunity to acknowledge the funding agencies: Institutional fellowship, Tezpur University and Research and Innovation Grant, Tezpur University, for the financial support.

Aftab Ansari

July, 2022

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## Abbreviations

IUPAC	International Union of Pure and Applied Chemistry
Ln	Lanthanides
Ac	Actinide
RE	Rare earth
REO	Rare earth oxides
REV	Rare earth vanadate
ET	Energy transfer
CT	Charge transfer
ED	Electric dipole
EDT	Electric dipole transition
MDT	Magnetic dipole transition
FRET	Förster resonant energy transfer
DDS	Drug delivery systems
MRI	Magneto resonance imaging
NP	Nanoparticles
Hb	Hemoglobin
RBC	Red blood cells
ROS	Reactive oxygen species
MS	Membrane skeleton
SEM	Scanning electron microscope
XRD	X-Ray diffraction
FWHM	Full width at half maximum
TEM	Transmission electron microscopy
XPS	X-ray photoelectron spectroscopy
TCSPC	Time correlated single photon counting
CR	Congo red
GdAc	Gadolinium acetate
GNP	Gd <sub>2</sub> O <sub>3</sub> nanopowder
EuAc	Europium acetate

EuGNP	Eu <sup>3+</sup> :Gd <sub>2</sub> O <sub>3</sub> nanoparticles
GNR	Gd <sub>2</sub> O <sub>3</sub> nanorod
DI	Deionized
W-H	Williamson-Hall
CTB	Charge transfer band
VBM	Valence band mapping
CLS	Core level spectra
GdV	GdVO <sub>4</sub> nanoparticles
EuGdV	Eu <sup>3+</sup> : GdVO <sub>4</sub> nanoparticles
DS	Debye-Scherrer
MOT	Molecular orbital theory
HOMO	Highest occupied molecular orbital
LOMO	Lowest unoccupied molecular orbital
TIM	Track interaction model
CTS	Charge transfer state
R/O	Red to Orange ratio
TC	Trapping centres
Irr-A	Irradiation A
Irr-B	Irradiation B
Irr-C	Irradiation C
Irr-D	Irradiation D
L-H	Langmuir-Hinshelwood
VB	Valence band
CB	Conduction band
PRT	Plasma recalcification time
CTRL0	Positive control
CTRL X	Negative control
VE	Vroman effect
PPP	Platelet poor plasma
PPC	Plasma protein corona

# Symbols

## Chapter I

$\gamma$	Gamma
$E_g$	Energy band gap
$\alpha$	Alpha
$\beta$	Beta

## Chapter II

$d_{WH}$	Crystallite size (from Williamson - Hall plot)
$\theta$	Bragg's angle
$E_{Ph}$	Phononic energy
$\varepsilon$	Microstrain
$\lambda$	X-ray wavelength
$d_{DS}$	Crystallite size (from Scherrer formula)
$h$	Planck's constant
$\nu$	Frequency
$\alpha$	Absorption coefficient
$R_{max}$	Maximum reflectance
$R_{min}$	Minimum reflectance
$l$	Optical path length
$\beta$	Full-width at half maximum

## Chapter III

T1	${}^5D_2 \rightarrow {}^7F_0$
T2	${}^5D_2 \rightarrow {}^7F_2$
T3	${}^5D_2 \rightarrow {}^7F_1$
T4	${}^5D_1 \rightarrow {}^7F_1$
T5	${}^5D_1 \rightarrow {}^7F_2$
T6	${}^5D_0 \rightarrow {}^7F_0$
T7	${}^5D_0 \rightarrow {}^7F_1$
T8	${}^5D_0 \rightarrow {}^7F_2$

T9	${}^5D_0 \rightarrow {}^7F_3$
T10	${}^5D_0 \rightarrow {}^7F_4$
$X_c$	Critical concentration
I	Intensity
e-h	Electron-hole pair

#### Chapter IV

R/O	Red to orange ratio
-----	---------------------

#### Chapter V

$\Gamma$	Reducible representation of movement of atoms
T	Translation like external mode
R	Rotation like mode
$A_g$	Symmetric with respect to the principle rotation axis and inversion
$B_g$	Anti-symmetric with respect to the principle rotation axis 'n' but symmetric to inversion
$E_g$	Doubly degenerate mode symmetric to inversion
$A_u$	Symmetric with respect to the principle rotation axis but anti-symmetric to inversion
$B_u$	Anti-symmetric with respect to the principle rotation axis n and anti-symmetric to inversion
$E_u$	Doubly degenerate mode anti-symmetric to inversion

#### Chapter VI

$C_0$	Concentration of dye
$C_t$	Concentration of dye after irradiation for time 't'
k	Pseudo first order rate constant

#### Chapter VII

$A_{\text{sample}}$	Absorbance of sample
$A_{\text{neg}}$	Absorbance of negative control
$A_{\text{pos}}$	Absorbance of positive control

CTRL O	Positive control
CTRL X	Negative control