

Declaration

I, **Ritayan Kashyap**, hereby declare that the present thesis, entitled “**Modelling and fabrication of Surface Plasmon Resonance (SPR) based sensor for the investigation of protein-protein interaction**”, is the record of work done by me under the supervision of Dr. Biplob Mondal, Associate Professor, Department of Electronics and Communication Engineering, Tezpur University, Tezpur. The contents of the thesis represent my original works that have not been previously submitted for any Degree/Diploma/Certificate in any other University or Institutions of Higher Education.

This thesis is being submitted to Tezpur University for the Degree of Doctor of Philosophy in Electronics and Communication Engineering.

Place: Tezpur University, Tezpur

Date: 22-07-2025


(Ritayan Kashyap)



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Dr. Biplob Mondal
Associate Professor
Department of Electronics and Communication Engineering
School of Engineering

Email: biplobm@tezu.ernet.in
Phone: 03712-267002

Certificate

This is to certify that the thesis entitled, “**Modelling and fabrication of Surface Plasmon Resonance (SPR) based sensor for the investigation of protein-protein interaction**”, submitted to the School of Engineering, Tezpur University in partial fulfillment for the award of the degree of Doctor of Philosophy in Electronics and Communication Engineering is a record of research work carried out by **Mr. Ritayan Kashyap** 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.

Date: 22-07-2025

Place: Tezpur

(Dr. Biplob Mondal)



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Certificate of the External Examiner

This is to certify that the thesis entitled, “**Modelling and fabrication of Surface Plasmon Resonance (SPR) based sensor for the investigation of protein-protein interaction**”, submitted by **Mr. Ritayan Kashyap**, Department of Electronics and Communication Engineering, School of Engineering, Tezpur University in partial fulfillment for the award of the degree of Doctor of Philosophy in Electronics and Communication Engineering has been examined by us on _____ and found to be satisfactory.

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

Supervisor

External Examiner

(Dr. Biplob Mondal)

()

Date: _____

Date: _____

Acknowledgement

At the very outset, I express my deepest sense of gratitude to my Ph.D. supervisor Dr. Bipob Mondal, Associate Professor, Department of Electronics and Communication Engineering, Tezpur University for his invaluable supervision, guidance and constructive suggestions throughout the current study.

I also extend my gratitude towards my Doctoral Committee members, Prof. Soumik Roy, Department of Electronics and Communication Engineering and Prof. Pabitra Nath, Department of Physics, Tezpur University for their valuable suggestions and discussions all throughout.

I would like to express my sincere thanks to the former Heads, Prof. Partha Pratim Sahu and Prof. Santanu Sharma, and the present Head, Prof. Bhabesh Deka of the Department of Electronics and Communication Engineering, Tezpur University. I also express my gratitude to all the faculty members and staff of the department for their co-operation during the whole duration of my Ph.D. course.

I would like to acknowledge DST-SERB (Grant No.EMR/2016/007445), Government of India and Research and Innovation Grant, Tezpur University for the financial support.

I offer my thanks to Prof. Robin Doley, Department of Molecular Biology and Biotechnology, Tezpur University and Prof. Gazi Ameen Ahmed, Department of Physics, Tezpur University for providing me access to the laboratory and research facilities. I would like to express my gratitude to my seniors and juniors from the Department of Molecular Biology and Biotechnology and Department of Physics, Dr. Namita Ojah, Dr. Rafika Yasmin, Dr. Susmita Thakur, Dr. Devalina Sarmah, Kaushik, Joyshree for their untiring support.

I express my sincere gratitude to Mr. Khargeshwar Rangpi and all the other staff of Central Workshop, Department of Mechanical Engineering, Tezpur University. I would like to thank the Sophisticated Analytical Instrument Center (SAIC), Tezpur University for providing facilities for characterization and express my gratitude to all staff members of SAIC. I am also thankful to the Nanoscale Materials and Devices

Laboratory, IIT Mandi for the thin film deposition facility. I would like to express my gratitude to my seniors of the Department of Electronics and Communication Engineering, Tezpur University and other departments, Dr. Satyajit Das, Dr. Palash Phukan, Dr. Jagat Das, Dr. Mukut Senapati, Dr. Rewrewa Narzary, Dr. Nithin Joseph Panicker, Dr. Trishna Barman, Dr. Rakcinpha Hatibaruah, Dr. Hilly Gohain Baruah, Dr. Satyabrat Malla Bujar Baruah, Suhas D, Dr. Shafiul Alom Ahmed and Dr. Kunal Pradhan for their invaluable support, guidance and encouragement throughout this journey. I offer my thanks to my co-Research Scholars and dear friends Biswajit, Deepamoni, Amarprit, Bedabrata, Sujoy, Anjana, Suhriday, Sritam, Karanjit, Nayab and Himangshu for all their help and support. I am thankful to my beloved present and former juniors from the Sensors and Systems Engineering (SenSE) Laboratory, Priyakshi, Orison, Ananya, Udit Rajbongsi, Udit Baruah, Manoj, Abhijeet, Pearleshwari, Pranab, Jugabrat, Kristina, Surojit, Asim and also juniors from the department whose cooperation and support has been crucial in my Ph.D. journey.

I am deeply grateful to my mother, Retd. Prof. Mukta Biswas, father, Retd. Prof. Ranjan Kumar Biswas, sister, Mrs. Debaleena Biswas, brother-in-law Mr. Arindam Bhattacharjee, my nephews Adi and Om, and all my friends for their unconditional support, strength and love.

Last but not the least, my heartiest thanks to the Almighty, who bestowed all his blessings on me.

Ritayan Kashyap

Dedicated to my

Parents.....

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Nomenclature

Symbols:

c	Velocity of light
CH_3	Methyl
d_k	Thickness of layer
g	Relative Centrifugal Force
h	Hours
K_{SP}	Propagation constant of the Surface Plasmon Wave
Kg	Kilogram
kV	Kilovolt
K_{ev}	Propagation constant of the evanescent wave
mA	Milliampere
min	Minutes
mm	Millimetre
mM	Millimolar
mW	Milliwatt
n_p	Refractive Index of the glass prism
Δn	Change in the Refractive Index
nm	Nanometre
ng/ml	Nanogram per milliliter
OH	Hydroxyl
q_k	Refractive index of layer
r	Reflection coefficient
RIU	Refractive Index Unit
R_p	Reflectivity
R^2	Regression coefficient
s	Seconds
S	Sensitivity
slpm	Standard litre per minute
v/v	Volume by volume
W	Watts
λ	Wavelength of light
λ_p	Plasma wavelength of gold
λ_c	Collision wavelength of gold
θ	Angle of incidence of light
Θ_{SPR}	Resonance angle
$\Delta\theta_{res}$	Shift in the resonance angle
$^\circ$	Degree
$^\circ\text{C}$	Degree Celsius
$\mu\text{g/ml}$	Microgram per milliliter
μL	Microlitre
\AA	Angstrom
β_k	Phase thickness of layer
ϵ_M	Dielectric constant of the metal layer
ϵ_S	Dielectric constant of the dielectric medium
ϵ_k	Permittivity of layer
ω	Frequency of the incident light

%	Percentage
γ_s	Surface energy
γ_s^D	Dispersive component of surface energy
γ_s^P	Polar component of surface energy
γ_t	Surface tension of the testing liquid
γ_t^D	Dispersive component of surface tension of the testing liquid
γ_t^P	Polar components of surface tension of the testing liquid

Abbreviations:

Ag	Silver
APDBD O ₂	Atmospheric Pressure Dielectric Barrier Discharge oxygen
3- APTMS	Aminopropyltrimethoxysilane
Ar	Argon
ATR	Attenuated Total Reflection
Au	Gold
BP	Black Phosphorous
BlueP	Blue Phosphorus
BSA	Bovine Serum Albumin
CMOS	Complementary Metal Oxide Semiconductor
CNC	Computer Numerical Control
Cr	Chromium
1D	One-Dimensional
2D	Two-Dimensional
3D	Three-Dimensional
DI	Deionised
DC	Direct current
DFT	Density Functional Theory
EDC	1-ethyl-3 (3-dimethylaminopropyl) carbodiimide
ELISA	Enzyme-linked Immunosorbent Assay
FTIR	Fourier Transform Infrared
FWHM	Full Width at Half Maximum
G-aHIgG	Goat anti Human Immunoglobulin-G
H-IgG	Human Immunoglobulin-G
IgG	Immunoglobulin-G
ITO	Indium Tin Oxide
LFA	Lateral Flow Assay
LoD	Limit of Detection
LSPR	Localized Surface Plasmon Resonance
M-aHIgG	Mouse anti Human Immunoglobulin-G
MoS ₂	Molybdenum Disulfide
MoSe ₂	Molybdenum Diselenide
11-MUA	Mercuptoundecanoic acid
NHS	N-hydroxysuccinimide
OWRK	Owens-Wendt-Rabel-Kaelble
PBS	Phosphate-Buffered Saline
PCR	Polymerase Chain Reaction
PDMS	Polydimethylsiloxane
PPP	Platelet Poor Plasma
QF	Quality Factor

RF	Radio Frequency
R-aHIgG	Rabbit anti Human Immunoglobulin-G
RI	Refractive Index
RIA	Radioimmunoassay
SAM	Self-Assembled Monolayer
SERS	Surface-Enhanced Raman Spectroscopy
SiO ₂	Silicon Dioxide
SPs	Surface Plasmons
SPR	Surface Plasmon Resonance
SPW	Surface Plasmon Wave
Ti	Titanium
TiO ₂	Titanium Dioxide
TMDCs	Transition Metal Dichalcogenides
TMM	Transfer Matrix Method
UV-Vis	Ultraviolet-Visible
vdW	van der Waals
WS ₂	Tungsten Disulfide
WSe ₂	Tungsten Diselenide
XRD	X-Ray Diffraction
ZnO	Zinc Oxide