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

(Ritayan Kashyap)

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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:** _____

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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	Millmolar
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
º	Degree
˚C	Degree Celsius
µg/ml	Microgram per milliliter
µL	Microlitre
Å	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
Υ_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_l^D	Dispersive component of surface tension of the testing liquid
γ_l^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