

Dedicated to

My Beloved

Parents, Sister, and Niece

Mr. Phouda Bahadur Bohora Chetry, Mrs. Asha Chetry,

Mrs. Anushree Kapila and Dityaa.

Thank you for your love, encouragement and support...

DECLARATION

I hereby declare that the thesis titled "*Fabrication and characterization of bio-based hybrid poly (vinyl alcohol)/carboxymethyl cellulose polymer films, reinforced with graphene oxide nanofiller for packaging applications*," submitted to the Department of Mechanical Engineering, Tezpur University, is an original piece of research carried out by me. All texts, figures, tables, and results that are not my own have been properly cited to acknowledge the original authors. All the sources of assistance received during the course of this work has been duly acknowledged. I further affirm that this work, in whole or in part, has not been submitted to any other University or Institution for the award of any degree, diploma, or similar qualification.

Date: 25/09/2025

Place: Tezpur University

Karanjit
(Karanjit Kapila)

Registration No.: TZ203940

Roll no.: MEP19102



तेजपुर विश्वविद्यालय / TEZPUR UNIVERSITY
(संसद के अधिनियम द्वारा स्थापित केंद्रीय विश्वविद्यालय)
(A Central University established by an Act of Parliament)
तेजपुर -784028 :: असम/ TEZPUR-784028 :: ASSAM

Dr. Sushen Kirtania
Associate Professor
Department of Mechanical Engineering
School of Engineering, Tezpur University

Email: sushen@tezu.ernet.in
Tel: +91-3712-27-5857 (O)
+91-99546-04524 (M)

CERTIFICATE OF THE SUPERVISOR

This is to certify that the thesis titled “*Fabrication and characterization of bio-based hybrid poly (vinyl alcohol)/carboxymethyl cellulose polymer films, reinforced with graphene oxide nanofiller for packaging applications,*” submitted to the School of Engineering, Tezpur University in partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy in Mechanical Engineering, is a bonafide record of original research carried out by **Mr. Karanjit Kapila** under my supervision and guidance. All sources of assistance and support have been appropriately acknowledged. I also certify that no part of this thesis has been submitted to any other institution or university for the award of any other degree or qualification.

Date: 25-09-2025

Place: Tezpur University

S. Kirtania
25-09-2025

Dr. Sushen Kirtania
Ph.D. Supervisor,
Department of Mechanical Engineering,
Tezpur University

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LIST OF FIGURES

| <u>Figure No.</u> | <u>Title</u> | <u>Page No.</u> |
|--------------------------|--|------------------------|
| Figure 1.1 | Classification of nanomaterials..... | 2 |
| Figure 1.2 | Graphene and its derivatives..... | 7 |
| Figure 1.3 | Environmental challenges associated with plastic materials..... | 11 |
| Figure 4.1 | Schematic diagram showing the fabrication of nanocomposite film | 56 |
| Figure 4.2 | PVA-based films with varying concentrations of GO (A) Neat PVA (B) PVA+GO (0.1%) (C) PVA+GO (0.3%) (D) PVA+GO (0.5 %) (E) PVA+GO (0.7%) | 56 |
| Figure 4.3 | SEM image of PVA/GO at 0.3% of GO (a) before and (b) after the tensile test..... | 58 |
| Figure 4.4 | UV-Vis light absorbance of PVA and PVA/GO films..... | 60 |
| Figure 4.5 | DSC analysis of PVA and PVA/GO films..... | 61 |
| Figure 4.6 | (a) TGA and (b) DTG thermographs of PVA and PVA/GO films..... | 63 |
| Figure 4.7 | MRC and WVP of PVA and PVA/GO films..... | 64 |
| Figure 4.8 | FTIR analysis of PVA and PVA/GO films..... | 66 |
| Figure 4.9 | Antibacterial activity by disk diffusion method..... | 67 |
| Figure 4.10 | Biodegradation test of (a) <i>B. subtilis</i> day 0 (b) day 3, full degradation of film observed (c) <i>P. putida</i> day 0 (d) day 3, full degradation of film (e and f) negative control (synthetic plastic) on day 3..... | 69 |
| Figure 4.11 | Soil burial degradation rate..... | 70 |
| Figure 4.12 | Soil burial analysis of PVA and PVA/GO films (a, b) soil preparation (c) samples (3×3 cm) (d) 20 th day sample degradation..... | 70 |
| Figure 5.1 | Schematic flowchart of diagram showing the fabrication of polymeric films..... | 80 |
| Figure 5.2 | Developed films P ₃ : PVA; P ₃ C _{0.5} : PVA+0.5% CMC; P ₃ C ₁ : PVA+1% CMC, P ₃ C _{1.5} : PVA+1.5% CMC..... | 80 |
| Figure 5.3 | SEM micrographs of P ₃ C _{0.5} film (a) before tensile test and (b) after tensile test..... | 82 |
| Figure 5.4 | (a) TGA and (b) DTG thermograph of developed films..... | 84 |

| | | |
|--------------------|---|---------|
| Figure 5.5 | UV-Vis light absorbance of the films..... | 86 |
| Figure 5.6 | FTIR spectra of film (a) P ₃ and (b) P ₃ C _{1.5} | 87 |
| Figure 5.7 | Antimicrobial activity by disk diffusion method (a) <i>S. aureus</i> (b) <i>E. coli</i> | 88 |
| Figure 5.8 | Soil burial analysis (a) soil preparation (b) films (3×3 cm) (c) 30 th day films degradation result..... | 89 |
| Figure 5.9 | Soil burial degradation rate of films..... | 89 |
| Figure 5.10 | Biodegradation analysis against (a) <i>B. subtilis</i> day 0; (b and c) day 2, sample P ₃ and P ₃ Q _{0.5} ; (d) <i>P. putida</i> day 0; (e and f) day 2, sample P ₃ and P ₃ Q _{0.5} ; (g) negative control (synthetic plastic) day 2..... | 91 |
| Figure 6.1 | Flowchart of experimental procedure for the development of nanofiber mats..... | 100 |
| Figure 6.2 | Schematic illustration for the development of nanofiber mats..... | 101 |
| Figure 6.3 | Polymer solution conductivity and viscosity..... | 103 |
| Figure 6.4 | Storage modulus (G'), loss modulus (G'') vs angular frequency..... | 104 |
| Figure 6.5 | Viscosity vs shear rate..... | 106 |
| Figure 6.6 | Shear stress vs shear rate..... | 108 |
| Figure 6.7 | (a) FESEM micrographs and (b) nanofiber diameter distribution..... | 109-110 |
| Figure 6.8 | TEM image of PVA/CMC/GO (a) 0.1 wt.% of GO (b) 0.3 wt.% of GO..... | 111 |
| Figure 6.9 | Thermal analysis (a) TGA (b) DTG..... | 113 |
| Figure 6.10 | Contact angle measurement of the developed nanofiber mats..... | 115 |
| Figure 6.11 | FTIR analysis of nanofiber mats..... | 117 |

LIST OF TABLES

| <u>Table No.</u> | <u>Title</u> | <u>Page No.</u> |
|-------------------------|--|------------------------|
| Table 4.1 | Thickness, and tensile properties of the developed films..... | 57 |
| Table 4.2 | Film's color, and barrier properties..... | 59 |
| Table 4.3 | Thermal properties of PVA and PVA/GO films..... | 62 |
| Table 4.4 | Comparison table of previous literature with present work..... | 65 |
| Table 4.5 | Inhibition zone diameter (mm)..... | 67 |
| Table 5.1 | Physical and mechanical result of the films..... | 81 |
| Table 5.2 | Comparison table of previous literature and the present study..... | 83 |
| Table 5.3 | Film's color and opacity value..... | 85 |
| Table 6.1 | Electrospin process parameters..... | 102 |
| Table 6.2 | Physical and mechanical properties of the nanofiber mats..... | 112 |

ABBREVIATIONS

| | |
|--------------------|---|
| NP | Nanoparticle |
| NC | Nanocomposites |
| CNT | Carbon nanotubes |
| GO | Graphene oxide |
| rGO | Reduced graphene oxide |
| PVA | Polyvinyl alcohol |
| CMC | Carboxymethyl cellulose |
| FDA | Food and Drug Administration |
| GRAS | Generally recognized as a safe |
| RH | Relative humidity |
| ES | Electrospinning |
| TS | Tensile strength |
| EAB | Elongation at break |
| YM | Young's modulus |
| SEM | Scanning electron microscopy |
| TEM | Transmission electron microscopy |
| DSC | Differential Scanning Calorimetry |
| TGA | Thermogravimetric analysis |
| DTG | Derivative thermogravimetric |
| WVP | Water vapor permeability |
| WVTR | Water vapor transmission rate |
| WCA | Water contact angle |
| MRC | Moisture retention capacity |
| FTIR | Fourier Transform Infrared Spectroscopy |
| <i>E. coli</i> | <i>Escherichia coli</i> |
| <i>S. aureus</i> | <i>Staphylococcus aureus</i> |
| <i>B. subtilis</i> | <i>Bacillus subtilis</i> |
| <i>P. putida</i> | <i>Pseudomonas putida</i> |

