Molecular Design of Sustainable Lignin-Based Advanced Materials

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About me

Education

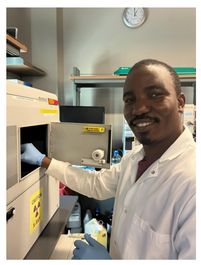
University of Illinois Chicago

❑PhD Chem. Engr. **Dec. 2026**

❑MSc Chem. Engr. **Dec. 2024**

University of Lagos

❑BSc Chem. Engr. **June 2014**



Publications & Presentations

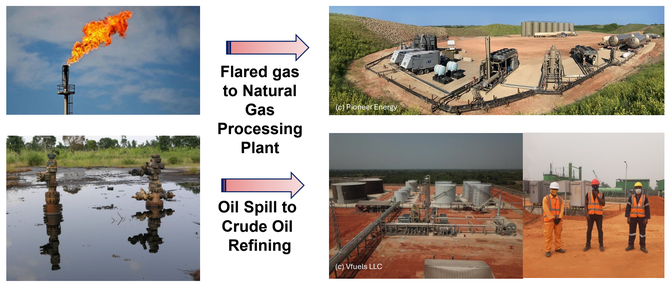
- 4 Publications, 25 citations
- 1 submitted article
- 1 innovation disclosure
- Conference Presentations: 6 Oral, 5 poster, 2 invited talks,

Professional Summary

Innovative researcher with expertise in materials science, polymers, & energy solutions, combining experimental research with computational modelling (DFT, MD, ML, process simulation) to accelerate R&D for products & processes that improve the quality of life at an affordable cost while protecting the planet.

Work Experience

Over seven (7) years of process engineering design and construction management converting waste to wealth and protecting the environment by replacing gas flaring with natural gas processing plants, and oil spillage with crude oil refineries, flow stations and pipeline infrastructures in Nigeria.



People Management

Supported student success in polymer science, computational methods courses in ChemE at UIC.

Mentored over 15 students (Undergrads, High Schoolers)

President, Chemical Engineering Grad. Student Association (ChEGSA) at UIC, 2025/26

Research Statement

My work integrates experimental and computational workflows to accelerate innovation in clean materials and energy systems. I have created value from waste streams—transforming flared natural gas and lignin into viable resources. From developing novel concepts to simulations & characterization, I translate scientific facts into economically viable and environmentally friendly processes. Looking ahead, I aim to develop products and processes leveraging my expertise in material science, & multiscale computational modelling.

Research Experience

❑ **Material Science and Polymer Chemistry:** Lignin to bioplastics, nanoparticles, polymers, fuels and chemicals. Experimentally versatile with SEM, FTIR, NMR, UV-vis, mechanical testing, XRD, TGA, HPLC, DLS, GPC, Rheology, Thermodynamic analysis, Biodegradation, TGA, Kinetics Modelling, DNA extraction & shotgun metagenomic analysis

❑**Multiscale computational modelling:** Density Functional Theory (DFT), Molecular Dynamics (MD), Machine Learning (ML), Process Simulation, Life cycle assessment (LCA) and Technoeconomic Analysis (TEA)

Overview of my PhD Research

The Challenge:

Heterogeneous & Irregular Lignin Structure limits its utilization

Nanoparticles – Control Particle Size

Size Analysis ***Solvent Effects*** ***Molecular Dynamics*** ***Sensing Performance***

Significance: Solvent properties control dissolution, attrition, precipitation, and the growth of lignin nanoparticles.

Bioplastics - Explore lignin diversity

Pulping Effects of lignin source on bioplastics ***Hardwood*** ***Softwood*** ***Grasses***

Blending Dynamics ***TGA*** ***mNGS*** ***LCA End-of-life management***

Significance: A detailed structure-property relationship for cellulose - lignin replacement for LDPE that biodegrade in 28 days. It has comparable Young Modulus, and surface roughness with LDPE, and comparable WVTR with Biobag.

Biopolymers - Control Monomers

Lignin Depolymerization ***Reaction Networks*** ***Ionic liquid Catalyzed polymerization*** ***Performance Evaluation***

Significance: Create high performance polymers from waste lignin

Computational Analysis

Plasticizer Screening ***Ionicity Predictors*** ***Biocompatible Ionic Liquids*** ***Solvent Screening***

Significance: Uncover mechanisms and screen to few viable candidates