

Inaugural Lecture by Prof. David Dodoo-Arhin

TITLE:

Beyond the Limit: Engineering Sustainable Solutions for Basic Human Needs

Abstract

The basic needs of humanity encompass a spectrum ranging from access to clean water, shelter, food security, to sustainable energy sources and beyond. However, in our pursuit of fulfilling these needs, we find ourselves at a crossroads where the traditional paradigms of consumption and production collide with the finite resources of our planet.

The crux of our discussion lies in understanding the symbiotic relationship between materials engineering and sustainability. From the utilization of renewable resources in manufacturing processes to the development of lightweight yet durable materials for infrastructure, every facet of our existence is intertwined with the principles of sustainable engineering.

Nanotechnology opens doors to unprecedented advancements in efficiency and functionality of local technologies in various sectors, including water purification systems, solar cells, agriculture, affordable and accessible healthcare solutions and the construction industry, while biodegradable polymers pave the way for eco-friendly packaging solutions. The fusion of traditional wisdom with modern innovation gives rise to sustainable construction materials that minimize environmental impact without compromising structural integrity. Yet, amidst the cacophony of technological marvels, we must not lose sight of the human element embedded within the fabric of sustainability. It is not merely about the materials we engineer, but the lives we touch, the communities we empower, and the legacy we leave behind for posterity.

This lecture will focus on the applications of Advanced Materials, Sustainable Energy Materials and Environmental Solutions Materials in nurturing the contextualized basic needs of humanity. The critical global issues such as climate change, resource scarcity and environmental degradation will be outlined highlighting solutions while meeting basic human needs.

Advocacy is made for the development of eco-friendly construction materials that reduce environmental impact, improve the thermal efficiency of buildings, lowering energy consumption and costs.

From the perspective of **Sustainable Energy Materials**, argument is made for the importance of materials that enhance the efficiency and affordability of renewable energy sources like solar cells / panel systems, capitalizing on Ghana's renewable energy potential. Our beloved nation, Ghana, stands at a crossroads—a juncture where our energy needs intersect with our commitment to sustainability. **“Dumsor”** (*translates to “off-on”*), characterized by frequent unpredictable power outages and load shedding, affects us all, disrupting daily life, hindering economic growth, straining our infrastructure and testing our resilience. We will explore if traditional solutions have reached their limits and propose some options beyond the conventional boundaries. The importance of scalable and sustainable energy storage solutions for a resilient energy infrastructure will be highlighted and linked with Ghana's 2018 discovery of significant lithium deposits.

From the **Environmental Solutions Materials perspective**, I highlight the importance of developing cost-effective materials and sustainable treatment technologies in reducing environmental pollution and improving water quality.

I will argue for the valorisation of biomass, agricultural and plastic waste to create valuable products, reducing waste and promoting a circular economy.

In tackling the Plastic Pollution menace, I will discuss innovative methods to recycle and valorise plastic waste, addressing Ghana's growing plastic pollution problem. Highlights of the Economic and Environmental Benefits of reducing environmental impact and creating economic opportunities through advanced recycling technologies are provided. The current community impact project, “Valorisation of Waste Plastics for Fuel Production (VALOPLASTIQUES)”, which seeks to remediate the menace of plastic waste by reprocessing them into high value fuels and chemicals for households, outboard motors and small running engines will be a key climaxing feature. Emphasis will be laid on the need for interdisciplinary research and collaboration to advance these sustainable solutions.

These arguments will be supported with specific examples from my research which have been the focus of my work over the past thirteen years.