UNIVERSITY OF ILORIN

THE TWO HUNDRED AND FORTY-SIXTH (246TH) INAUGURAL LECTURE

"ENGINEERING MATERIALS DEVELOPMENT AS CATALYST FOR INNOVATION"

By

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THURSDAY, 23RD NOVEMBER, 2023

This 246th Inaugural Lecture was delivered under the Chairmanship of:

The Vice-Chancellor

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23rd November, 2023

ISBN: 978-978-8556-41-1

Published by:

The Library and Publications Committee,
University of Ilorin, Ilorin, Nigeria.

Printed by
Unilorin Press, Ilorin, Nigeria.

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All other Academic colleagues,
All Non-teaching Staff,
My Lords, Spiritual and Temporal,
Members of my Nuclear and Extended Families,
Distinguished students of Materials and Metallurgical Engineering,
Great students of the University of Ilorin,
Esteemed Invited Guests, Friends and Relatives,
Gentlemen of the Press, Print and Electronic Media,
Distinguished Ladies and Gentlemen.

Preamble

I seek refuge in Allah by His munificent and primordial power against the Shaitan, the accursed, and I start today's presentation of my inaugural lecture in the name of Allah, the most Beneficent, the most Merciful. Allah! There is none worthy of worship but He, the Ever Living, the one Who sustains and protects all that exists. Neither slumber nor sleep overtakes Him. To Him belongs whatever is in the heavens and whatever is on earth. Who is he that can intercede with Him except with His permission? He knows what happens to His creatures in this world, and what will happen to them in the hereafter. And, they will never encompass anything of His knowledge except that He wills. His throne extends over the heavens and the earth, and He feels no fatigue in guarding and preserving them. Allah SWT is the Most High, the Most Great.

Mr. Vice-Chancellor, my distinguished audience, it is with immense gratitude to the Almighty and All-Knowing Allah (SWT) and indeed a great privilege that I, Jamiu Kolawole ODUSOTE, who started my life as "Omo Ile kewu" and lived in Modrasa for close to ten years (March 1983 to November 1992), is standing before you today, as the first Professor in the Department of Materials and Metallurgical Engineering of the University of Ilorin, to deliver the very first inaugural lecture from the Department. Kindly join me in thanking Allah (SWT) for giving me this special opportunity on this special day, which coincides with the birthday of my son, Abdulqayyum and my humble self. *Alhamdulilahi Alasi biniimatihi tatimu solihah!*

Mr. Vice-Chancellor, today's inaugural lecture entitled "Engineering Materials Development as Catalyst for Innovation" is the 246th in the series of inaugural lectures to be delivered in the University of Ilorin, 19th in the Faculty of Engineering and Technology, and 1st from the Department of Materials and Metallurgical Engineering.

Mr. Vice-Chancellor, in today's lecture, the critical role of materials development as a prime mover of modern technological development and innovation will be examined. I stand before you today with great excitement and a profound sense of privilege to deliver this inaugural lecture on a topic that lies at the very heart of progress and transformation in our world: "Engineering Materials Development as Catalyst for Innovation." In this lecture, I shall embark on a journey through the remarkable evolution of engineering materials and their pivotal role in shaping our modern world. I will illuminate the transformative role of engineering materials in the context of innovation, demonstrating how they stimulate breakthroughs, disrupt traditional paradigms, and reshape industries. Their impact reverberates across different sectors, from healthcare to energy, from infrastructure to consumer goods, and beyond, contributing to the betterment of our society. I therefore invite you to join me on journey as I unveil the impact of engineering materials, from metals that have withstood the test of time to composites that are reshaping the landscape of possibility, on technological innovation.

According to Afonja, (2002), the ability to produce the needed engineering materials for the advancement of technology in areas such as energy and power, communication, aerospace, biomedical engineering, internet of things, etc is the greatest achievement of researchers in the last century or thereabouts. This shows that every new or modern technological development, advancement and innovation depends primarily on the selection, design, production and availability of the appropriate engineering materials. This shows that materials development is the major driving force that makes technology moves and sustains the World. Thus, Materials Science and Engineering is a critical intellectually exciting field that is very critical to the success of all other engineering fields for global technological advancement and breakthroughs, towards the development of manufacturing industries, economic growth, national security and defence (National Research Council, 1989).

Introduction

Innovation, the lifeblood of progress, is an enduring force that propels societies and industries toward new horizons of achievement. At the heart of innovation lies the intricate interplay between scientific ingenuity and practical application. One indispensable facet of this synergy is the dynamic universe of engineering materials.

Engineering materials, ranging from the venerable metals that have shaped our civilization for millennia to the cutting-edge composites that are redefining the boundaries of possibility, serve as the very catalyst for innovation. They are the enablers, the building blocks, and the transformative agents that allow us to transcend the limits of the past and craft the future with unparalleled precision and sophistication.

Materials Science and Engineering is a multidisciplinary training, research and development field that is focused on generation and application of knowledge relating to the composition, structure and processing of materials to their properties and applications. The multidisciplinary nature of materials science and engineering is evident in Figure 1 (Hira *et al.,* 2023), as the majority of Scientists and Engineers in varying degrees are working in the field. Figure 1 shows the inter-relationship between materials processing, structure, properties, and performance. In addition, there is tendency that Materials Scientists will focus on the structure-property relationship, while Materials Engineers will focus on the processing-performance relationship. However, in Materials Science and Engineering, each part of the tetrahedron is focused on, with characterisation at each stage. Based on the multidisciplinary nature of the field, many technological advances and development in other fields of engineering are closely related with progress in Materials Research and Development. Thus, the greatest achievements in the area of technology in the last century were the ability to produce materials that were used for development of components/machines that brought about industrial revolution (Afonja, 2002). In the last century, the development of the steam engine, turbo-jet engine, nuclear power, computer hardware, laser, biomedical implants, space jets, telecommunication/internet gadgets, smart phones, iPods, iPads, etc, was made possible through the efforts of materials Scientists and Engineers, who produce appropriates materials for their components.

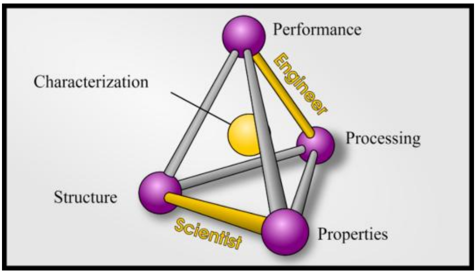

Figure 1: Materials Tetrahedron (Hira et al., 2023)

Mr. Vice-Chancellor, engineering materials that can withstand aggressive operating environment such as ultra-high temperatures in aerospace, oil and gas and other industries, have been studied by our team. **Odusote** *et al.,* (2012a, 2012b, 2012c, 2013a, 2013b, 2014) assessed the oxidation of a Pt-based alloy for ultra-high temperature application in turbine engines. Eco-friendly, green corrosion inhibitors extracted from different plant parts such as *Jathropha curcas* leaf (**Odusote** and Ajayi, 2013; Ajayi, **Odusote**, and Yahaya, 2014; **Odusote** and Ajayi, 2016); *Plukenetia conophora* leaf (**Odusote**, Ayanda and Yahya, 2017; **Odusote** *et al.,* 2020); Moringa oleifera (**Odusote** *et al.,* 2016); hybrid leaf (Ikubani, Adeleke, **Odusote**, 2023), and from green nanoparticles (**Odusote** et al., 2020, Asafa, **Odusote** *et al.,* 2020, **Odusote** *et al.,* 2023, Ikubani, Adeleke, **Odusote** *et al.,* 2023) were studied for corrosion control of mild steel and other materials used in oil and gas industry. Most recently, renewable energy is generated through conversion of bio-waste (biomass) to smokeless composite briquettes (**Odusote** and Muraina, 2017; Muraina, **Odusote**, Adeleke, 2017; Ajimotokan, Ibitoye, **Odusote**, 2019). New composite and other specially engineered materials with fantastic strength-to-weight-ratios that fit for applications in aerospace and space shuttle, automobile, iron and steel, and food industries are being developed towards technological advancements and innovation in those industries. Without the development and availability of appropriate engineering materials, which will provide the key to viable designs and production, technological advancements, innovations and outstanding systems, devices, appliances, tools, robots, etc., would not be possible in this century or even in the very distant future.

Mr. Vice-Chancellor, development of materials has played and still playing a very critical role in the existence, development and survival of mankind. The quality of our life today is gradually being determined by the development and availability of the requisite, optimal materials and technologies. Man has continued to be heavily dependent on materials for tools, clothing, shelter, hunting, agriculture, transportation, recreation, military weaponry, etc., from pre-historic times till today. Thus, notable materials (the Stone Age, the Bronze Age and the Iron Age) have been used by historians to define or label the various civilizations based on the recognizable material in dominant use for human endeavours during the periods. Tens of thousands of different materials have been developed by the modern-man from metals and non-metals using the initial knowledge-based materials technologies. Today, a myriad of categories of materials including metals and their alloys, polymers, plastics, rubber, ceramics and glasses, composites, laminated particle and treated woods, biomaterials; sol-gel, hydrogels, Micro/Nano-electromechanical Systems (MEMS/NEMS), carbon nano-tubes, wires, ‘smart materials’, etc, have been developed by materials engineers and scientists. Our lives today are being defined by these engineering materials through their structure, processing, properties and performance as they are being developed into useful products – components, machines, devices, tools, utensils, structural materials, body-armour, weapons, airplanes, ornaments, etc.

Mr. Vice- Chancellor, for us to appreciate the importance of materials/Materials Engineers in our daily lives, I wish to quote Afonja, (1986) here:

> "Perhaps the best way to appreciate the indispensability of materials to mankind is to review a few hours in a typical day in the life of an average modern man. He wakes up in the morning from a bed made of wood, steel and polymer, cleans his teeth with a brush made from polypropylene handle and

nylon bristles, he takes his bath in an enamel plated steel bathtub, he dresses up wearing a nylon shirt, a terylene suit, leather shoes, and a quartz wristwatch. He takes his tea from a ceramic tea cup, or one drawn from an 18/8 grade stainless steel-jug and takes his breakfast with fork, knife, spoon of drawn and plated stainless steel. He drives to work in a car which comprises iron, steel, copper, aluminium, zinc, glass, plastics, rubber, and hundreds of other materials, listening to the news on his radio which is made of semiconductor transistors, silicon-based chips, metallic and ceramic resistors, etc. He signs into his office with a biro with at least five different materials - polyethylene for the ink holder, polystyrene for the shaft, polypropylene for the cap, copper alloy for the tip holder, and tungsten carbide for the tip/ball. This is only the beginning of a day during which hundreds of materials may be used. Indeed, man is always in contact with at least a major material at any moment in his life cycle. Clearly, materials play a very critical role in the existence and development of mankind" - end of quote!

Our modern home is full of different ranges of materials from the bricks, to beddings, tiles, and sophisticated kitchen transformed by progress in materials development: aesthetic vinyl polymers in floor tiles; stainless steel in sinks; pyro-ceramic and Teflon in cookware (non-sticky cooking utensils), etc. Today, water filtration system now uses advanced materials developed from gold, silica, carbon-nanotubes, etc, to produce clean water for all. Materials development is contributing immensely to our livelihood. Thus, the state of development of any nation and the type of livelihood of a nation is connected to the level of its advancement in materials development. Most of the developed countries such as USA, UK, Canada, Germany, South Korea, Japan, France, Norway and Sweden are countries that produce very high-quality materials, and also have high Gross Domestic Product (GDP) and Gross National Product (GNP). This clearly indicates materials science and engineering plays a crucial role in economic growth through materials development. It is therefore pertinent to provide necessary tools and environment for the materials Scientists and Engineers to develop wide range of materials for our economic growth and development.

Mr. Vice-Chancellor, Materials and Metallurgical Engineering just like Materials Science and Engineering, is also a multidisciplinary field that plays vital role in designing, developing and characterisation of new engineering materials that leads to technological advancement in various fields such as transportation, construction (building, road, rail, etc), military weaponry and defence-armoury, oil and gas, communication, electronics, mechatronics, computer hardware, telecommunication and information technology. In addition, the development of surgical implants for orthopaedic, dental, neurosurgeons are also made possible through continuous development of improved engineering materials.

Mr. Vice-Chancellor, my research takes a particular focus on materials development for applications in industries such as oil and gas (**Odusote** and Ajayi, 2013; Ajayi, **Odusote**, and Yahaya, 2014; **Odusote** and Ajayi, 2016; **Odusote**, Ayanda and Yahya, 2017; **Odusote** *et al.*, 2020; **Odusote** *et al.*, 2016; Ikubani, Adeleke, **Odusote**…, 2023; **Odusote** *et al.*, 2020; Asafa, **Odusote** *et al.*, 2020; **Odusote** *et al.*, 2023; Ikubani, Adeleke, **Odusote** *et al.*, **2023**), turbine engines (**Odusote** *et al.*, 2012a, 2012b, 2012c, 2013a, 2013b, 2014), construction (**Odusote** and Adeleke, 2012; Adeleke and **Odusote**, 2013, Kolawole and **Odusote**, 2013; **Odusote**, Onowuma, Fodeke, 2016; Alabi, Ayoade, **Odusote** and Adeleke, 2016; **Odusote** and Dosunmu, 2018; Adeleke, **Odusote** *et al.*, 2018; **Odusote** *et al.*, 2019;

Odusote and Dosunmu, 2019), biomedical (**Odusote** *et al.*, 2016; **Odusote** and Oyewo, 2016; **Odusote** et al., 2019; **Odusote** *et al.*, 2023), automobile (**Odusote**, Talabi and Agodinrin, 2014; **Odusote**, Adeleke and Ajayi, 2015; **Odusote** and Ajayi, 2016; **Odusote**, Adeleke and Muraina, 2019; **Odusote**, Tanimowo and Tiedje, 2019; **Odusote** *et al.,* 2021), and energy and fuel composite (Oboirien…, **Odusote and Sadiku,** 2018; **Odusote** *et al.,* 2019; Adeleke, **Odusote** *et al.*, 2019a; Adeleke, **Odusote** *et al.,* 2019b; Adeleke, **Odusote** *et al.,* 2020; Adeleke, **Odusote** *et al.,* 2021a; Adeleke, **Odusote** *et al.,* 2021b; Adeleke, **Odusote** *et al.,* 2021c; Adeleke, **Odusote** *et al.,* 2021d, …Odusote et al., 2021; Adeleke, **Odusote** *et al.*, 2022a; Adeleke, **Odusote et al.,** 2022b; Adeleke, **Odusote** *et al.,* 2022c). These specialized areas of research have been an integral part of my academic journey, offering unique insights into the behaviour of materials in different environment and applications.

Mr. Vice-Chancellor, permit me to provide basic information about the various categories of engineering materials.

Engineering Materials

A group of materials that are used in the production/ construction of engineering structures and components is referred to as Engineering Materials. These materials are selected for applications based on their properties such as mechanical, physical, chemical, microstructural, and manufacturing properties. The primary function of an engineering material is to withstand applied loading without breaking/failure and without exhibiting excessive deflection, as well as withstand the application environment without degradation.

Engineering materials can be broadly classified into metals and non-metals. While non-metals include polymers, ceramics, and composites, metals can either be ferrous or non-ferrous as shown in Figure 2.

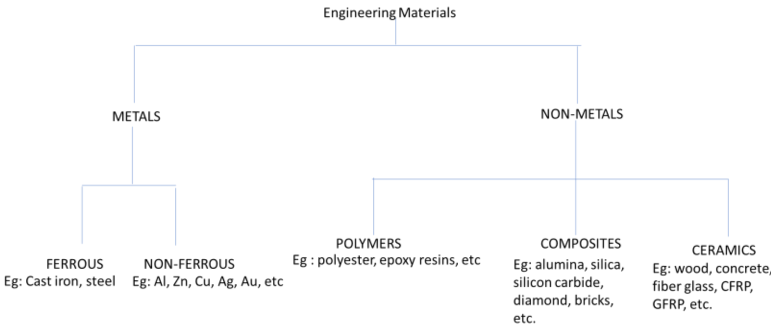

Figure 2: Classification of Engineering Materials (**Odusote,** 2023)

Metals: The Foundation of Innovation

From the dawn of human history, metals have been the embodiment of our transformative journey. They have been the bedrock upon which we have forged empires, constructed towering skyscrapers, and propelled ourselves to the farthest reaches of space. But the tale of innovation doesn't end there; it evolves, just as our dreams and aspirations do. From the Bronze Age, when copper and tin were combined to create a superior alloy, to the Industrial Revolution, when the mass production of steel transformed societies, metals have been at the forefront of innovation.

Metallurgy, the science and art of working with metals, emerged as a defining discipline in human history, and has been pivotal in unlocking the potential of metals. It marked the transition from stone tools to the revolutionary use of metals, leading to significant advancements in agriculture, architecture, and warfare. Metallurgical process includes extraction of metals from their ores, purification and alloying, heat treatment, and metal working (hot or cold), etc. My research studies on metals and non-metals have been an expedition into the very essence of innovation, a journey where we challenge the boundaries of what we know and push towards the boundaries of what we can achieve.

Metals are polycrystalline bodies which have a number of differentially oriented fine crystals. Normally, majority of metals are in solid states at ambient temperature and pressure. However, some metals such as mercury are also in liquid state at ambient temperature. All metals have high thermal and electrical conductivities, as well as positive temperature coefficient of resistance. This means electrical resistance of metals increases with increase in temperature.

Examples of metals – Silver, Copper, Gold, Aluminium, Iron, Zinc, Lead, Tin, etc. Metals can be further divided into two groups:

1. **Ferrous Metals –** All ferrous metals have iron as common element. All ferrous materials have very high permeability which makes these materials suitable for construction of core electrical machines. Examples: Cast Iron, Wrought Iron, Steel, Silicon Steel, High Speed Steel, Spring Steel etc.
2. **Non-Ferrous Metals -** All non-ferrous metals have very low permeability. Example: Silver, Copper, Gold, Aluminium etc.

Ferrous metals:

The primary contents of ferrous metals are iron and carbon. Ferrous metals are magnetic and are vulnerable to rust when exposed to moisture. Examples include, cast iron, steel, etc. Steel can be broadly classified into plain carbon steels; low alloy steels; stainless steels; and tool steels. Gray cast iron, white cast iron, malleable cast iron and ductile cast iron are the major classification of cast irons.

Ferrous metals are used for construction of engineering infrastructures, automobile parts, industrial cutting tools, etc, because of their high strength. They are also used in motor and electrical applications due to their magnetic property.

Non-Ferrous Metals:

These are metals and alloys not based on iron. That is, iron is not their primary constituent. Most important engineering materials in this group are aluminium, copper, nickel, magnesium, titanium, gold, platinum, tungsten and zinc and their alloys. Some of these non-ferrous metals have good corrosion resistance and strength-weight ratio that make them competitive with steel in moderate-high stress applications. These metals also have properties other than mechanical strength that make them appropriate for applications where steels are not be suitable. The properties of these non-ferrous metals can easily be modified or improved through alloying or by addition of reinforcing materials in metal matrix composites (**Odusote** et al., 2023).

Non-metals: The Pioneers of Novelty

In the realm of materials science, non-metals emerge as the trailblazers of novelty, ushering in a new era of possibilities. These diverse substances, with their unique properties and applications, have continuously driven innovation across various industries, redefining the boundaries of what is achievable. This narrative unravels the exceptional contributions of non-metals in shaping the landscape of modern technology and science.

Non-Metallic materials are non-crystalline in nature. These exist in amorphous or mesomorphic forms. These are available in both solid and gaseous forms at ambient temperature. Normally, all non-metals are bad conductor of heat and electricity. The realm of non-metals encompasses a vast array of elements and compounds such as plastics, rubber, leathers, ceramics, asbestos, etc., that exhibit properties distinct from metals. These materials are integral to our daily lives and have a profound impact on various industries, from electronics to healthcare and beyond.

Mr. Vice-Chancellor, one of the most crucial categories of non-metals is semiconductors. Silicon, in particular, is the cornerstone of modern electronics. Semiconductors possess a unique property: they can conduct electricity under specific conditions but also act as insulators under different circumstances. This property enables the creation of transistors, the fundamental building blocks of digital circuits. Semiconductor devices, such as microprocessors and memory chips, have revolutionized computing and telecommunications industries. The relentless miniaturization of transistors, often referred to as Moore's Law, has led to exponential growth in computing power, paving the way for innovations like smartphones, artificial intelligence, and Internet of Things (IoT). An investigation by Odusote and his coworkers (Adepoju et al., 2016) has shown that silica, from which silicon could be obtained, could be extracted from cassava periderm and other agro-residues.

Non-metals are also the primary constituents of polymers, which include thermoplastics such as polyethylene and polypropylene as well as thermosetting resins such as epoxy resins and phenolic resins. Polymers are ubiquitous in our daily lives; from the plastic bottles we use for storage to the synthetic textiles we wear. It has chain molecular structure with carbon as back bone atom. Their versatility, lightweight nature, and ease of processing have made them indispensable in industries as diverse as packaging, automotive manufacturing, and healthcare. Polymers are not only used as structural materials; they can be used as reinforcement fibres and resins in the matrix of composite materials.

Mr. Vice-Chancellor, there are also natural polymers. Natural polymers, often derived from biological sources, offer a wide range of properties and applications, making them a subject of great interest in materials science and engineering, especially for biomedical applications because of their good biocompatibility and biodegradability, which make them to be environmentally friendly. Natural polymers are organic compounds made up of repeating units called monomers. These materials are abundant in the natural world and can be found in various forms, from the cellulose in plants to the proteins in our bodies. Cellulose is perhaps one of the most abundant natural polymers on Earth. It is the main structural component of plant cell walls and provides rigidity and strength to plant structures. Recent advancements in nanotechnology have led to the development of nanocellulose, a highly versatile material with applications in nanocomposites, sensors, and even wound dressings.

Mr. Vice-Chancellor, there is also the fascinating world of elastomers. Elastomers are a class of polymers known for their unique properties that enable them to elastically stretch and return to their original shape. These materials have a distinctive ability to undergo large deformations under stress and subsequently return to their original shape when the stress is removed. This property sets elastomers apart from other polymers, making them invaluable in various applications across industries and plays a pivotal role in engineering and materials science. Elastomers can be found both in natural form and can be synthesized in the laboratory. Natural rubber, derived from the latex of rubber trees, is one of the most well-known natural elastomers. It has been used for centuries by indigenous cultures for its remarkable elasticity. However, synthetic elastomers, such as neoprene, silicone rubber, and polyurethane, have been synthesized to meet specific industrial and commercial needs. While elastomers offer exceptional elasticity, they also face challenges such as aging, fatigue, and environmental degradation.

Ceramics, another category of non-metals, excel in high-temperature and harsh environments. Ceramics are mainly oxides, nitrides and carbides. They are non-conducting materials; due to its insulating property they are used as insulators. They are very hard and brittle in nature. Ceramics have regular atomic and crystal structures. They are known for their exceptional heat resistance, hardness, and electrical insulation properties. Ceramics examples include fireclay, alumina, silica, silicon carbide, diamond, etc. Because of their good thermal insulation, ceramic bricks are used in ovens and furnaces. Diamond is another ceramic material used as ornament and in cutting tools applications.

Vice-Chancellor sir, in addition to these versatile materials, composites, which combine non-metallic matrices with reinforcing materials like fibres or particles, represent another exciting facet of modern materials science and engineering. While metals have played a central role in engineering, the quest for innovation has driven us beyond their limits. The transition from traditional metals to advanced materials, such as polymers, ceramics, and semiconductors, has expanded the horizons of what is achievable. Composites, a relatively recent addition to our materials toolkit, represent the pinnacle of innovation. Composites combine different materials to create structures that possess unique properties. Whether it's the carbon-fibre-reinforced composites used in aerospace or advanced medical implants, these materials have transformed industries. They offer a unique blend of properties that often exceeds those of individual components, making them invaluable in a wide range of applications across various industries. There are several types of composites, including fibre-reinforced composites, particulate-reinforced composites, and structural composites. Fiber-reinforced composites involved embedding high-strength fibres, such as carbon, glass, or aramid, within a matrix material, often made of polymers, metals, or ceramics. The fibres provide strength and stiffness, while the matrix material helps distribute stresses and protects the fibres (**Odusote** *et al*., 2016; **Odusote** and Oyewo, 2016; Oyewo, Ajide, **Odusote**, 2019). This combination results in a material that is both strong and lightweight, making it ideal for applications where high strength-to-weight ratios are crucial.

Mr. Vice-Chancellor, materials have always been, and will continue to be, the unsung heroes of innovation. From the earliest days of civilization, when humans first discovered the utility of metals, to the present era of advanced composites and nanomaterials, engineering materials have been the silent enablers of progress. Today, we will embark on a journey to understand how materials have evolved from metals to composites and the profound impact they have had on our world.

Vice-Chancellor sir, the role of engineering materials development in technological advancement and innovation is highlighted in this lecture. I have had great opportunity of making some modest contributions in the area of engineering materials development from metals to composites; heat treatment and development of quenchants, high temperature study of turbine engine components, biomass waste to energy products, development of biomaterials, corrosion study and control through the use of green inhibitors, among others. As I delve into the vast expanse of my research, particularly in the realms of metals and composites, I am filled with an unwavering conviction that these materials are the true catalyst for innovation.

Mr. Vice-Chancellor, permit me to discuss few of my contributions to knowledge of materials development towards technological innovations in modern era.

Development of turbine engine component

Before the gas turbine, applications which demand that metals must sustain high stress without fracture or plastic deformation when red hot did not exist. The early turbine engines were operating at 700 °C and their blades were made from special stainless steels (Sims et al., 1987). The efficiency of turbine engines depends largely on the operating temperature, and thus, increase in the operating temperature of turbine engines will improve their efficiency, reduce their fuel consumption and CO_2 emission, and enable greater thrust (Sim *et al.,* 1987; Yokokawa *et al.,* 2003). Nickel-based superalloys (NBSAs), currently being used for production of hot section components of turbine engines, are reaching their temperature limit (because they are operating close (~90%) to the melting point of nickel, 1455°C). Platinum-based alloys are being developed as a possible replacement for some of the currently used nickel-based superalloy components, in applications where higher operating temperatures of about 1300°C to 1350°C, as well as better environmental resistance are critical but higher density effect is less harmful.

In the dynamic field of aerospace engineering, where innovation is the key to conquering the skies and beyond, my research is uniquely centred on the high-temperature oxidation of

Pt-based alloys. This specialized area of investigation holds a pivotal role in enhancing the performance and durability of materials under extreme aerospace conditions. In my own research, I have had the privilege of delving into the isothermal oxidation behaviour of Pt-based alloys. I have observed how these alloys perform under extreme conditions, such as exposure to temperatures as high as 1350°C. The results have provided valuable insights into the oxidation behaviour of these materials, underpinning their potential for high-temperature applications.

Mr. Vice-Chancellor sir, I have explored the high-temperature oxidation of Pt–Al–Cr–Ru alloy. What makes this alloy intriguing is not just its resistance to oxidation but the absence of a zone of discontinuous oxides, a phenomenon that sets it apart from conventional materials. It is a testament to the diverse array of materials that have emerged and their potential to redefine our engineering landscape.

As we explore the broader theme of engineering materials from metals to composites, the study of Pt-based alloys occupies a distinctive place. These alloys, with their remarkable resistance to oxidation even at elevated temperatures, hold the promise of revolutionizing industries that rely on high-temperature applications. High temperature oxidation resistance is a critical property when considering materials for high temperature applications. This is because degradation by oxidation is one of the main failure modes of hot-section components in gas turbines, due to rapid material consumption at high temperatures (Sims et al., 1987, **Odusote** *et al.*, 2012a). The high temperature oxidation evaluations can assist in determining the possible operating performance of the materials, especially since high temperature oxidation effects become increasingly significant with increasing operating temperatures. By understanding the mechanisms underlying their oxidation behaviour, I have been able to unlock the potential for enhanced durability and efficiency in critical processes, especially for aerospace propulsion.

Odusote *et al.,* (2012a) examined the isothermal oxidation behaviour of a two-Phase γ/γ' precipitation-hardened quaternary Pt-based alloy in air at 1350 °C. They reported that a well-adhering, continuous and protective α-Al_2O_3 scales with no spallation was formed during oxidation, irrespective of the exposure time. There was neither a zone of discontinuous oxides, nor any other internal oxidation observed as shown in Figure 3. The depth of the Al depletion zone was not detected while the oxide grain sizes increased with increased exposure time, and the scale growth kinetics obeyed the parabolic rate law at all the exposure temperature (Figure 4). Good adhesion of the α-Al_2O_3 scale to the substrate of the alloy was found to be dependent on the mechanical- keying of the scale to the substrate due to protrusions of the alloy into the scale, which gave rise to an irregular scale–substrate interface (**Odusote** *et al.,* 2012b). The results indicated that Pt-based alloy has a promising potential for high-temperature applications.

Oxidation kinetics and mechanisms of growth of alumina scale on precipitation-hardened Pt–Al–Cr–Ru alloys were studied by **Odusote**, Cornish and Chown (2012c). Their results showed that the mechanisms of α-Al_2O_3 growth was mainly by inward diffusion of oxygen along the oxide grain boundaries, with some outward diffusion of aluminium ions along the short circuit paths, such as pores (Figure 5). Furthermore, **Odusote**, Cornish and Papo (2013a) assessed the oxidation behavior of Pt-based alloys for application in high temperature applications. They reported that the oxide scale thickens with increased exposure time and temperatures according to parabolic kinetics. It was concluded from the results that the Pt-based alloys possess good oxidation resistance and thus will be suitable for high temperature applications, such as turbine engines.

The residual stresses in the scales of the alloy specimens oxidized in air at 1150 °C for up to 100 hours were measured using Raman luminescence piezospectroscopy by **Odusote** *et al.*, 2012d. The study's exploration of the oxidation behaviour of the alloy at those conditions is of significant relevance to aerospace industries. The results from scanning electron microscopy equipped with energy dispersive spectroscopy, optical microscopy, X-ray diffraction and Raman spectroscopy showed that well-adhering, irregular and protective external α-Al_2O_3 scales developed on all specimens. Notably, the formation of well-adhering, continuous, and protective α-Al_2O_3 scales with no spallation regardless of exposure time is a crucial finding. This observation underscores the alloy's resilience and ability to maintain its integrity under extreme conditions. The absence of a zone of discontinuous oxides and internal oxidation further reinforces the alloy's potential for high-temperature applications. The absence of a zone of discontinuous oxides and the similarity to a Pt–10Al–4Cr alloy with a discontinuous oxide zone is an intriguing observation. This indicates that the alloy under investigation possesses unique characteristics that set it apart from conventional materials, potentially making it a valuable candidate for high-temperature applications.

The increase in oxide grain sizes with prolonged exposure time, following the parabolic rate law for scale growth kinetics as shown in Table 1, provides valuable information for predicting material behaviour over extended periods. The specific thickness of the oxide scales on water-quenched and air-cooled specimens after 100 hours of exposure highlights the alloy's stability and consistent performance. The room-temperature residual stresses were found to be compressive and became independent of oxidation times above 10 hours exposure. Stress measurement results suggest that the air-cooled specimens possessed better adhesion than the water-quenched specimens, while both displayed lower stress values than those of the Ni- and Fe-based superalloys. The nature and magnitude of stress in the scales formed on Pt_{84}:Al_{11}:Cr_3:Ru_2 (at.%) alloy oxidized in air at 1250°C and 1350 °C, for up to 500 h, have also been determined (**Odusote** *et al.*, 2014). This is to establish their long-term viability during high-temperature applications. Residual stress in the scales, which was measured using luminescence piezospectroscopy was found to be compressive. It decreased gradually with increased oxidation time, before reaching a constant value. The compressive stress was also found to be lower than those of other Ni- and Fe-based superalloys. It was concluded that the investigated Pt_{84}:Al_{11}:Cr_3:Ru_2 (at.%) alloy has a promising potential for high-temperature applications.

Table 1: Parabolic rate constants for water-quenched Pt_{84}:Al_{11}:Cr_3:Ru_2 (at.%) isothermally oxidized between 1150-1350 °C in air for up to 100 hours (**Odusote** *et al.*, 2012b)

Oxidation temperature (°C)	Mass-related rate constants, k_p ($mg^2/cm^4.h$)	Intercept (mg^2/cm^4)	Thickness-related rate constants, k_{ps} ($\mu m^2/h$)	Intercept (μm^2)
1150	0.0007 ± 0.0001	0.25 ± 0.05	0.0983 ± 0.0005	0.53 ± 0.07
1250	0.0021 ± 0.0001	0.24 ± 0.07	0.2808 ± 0.0007	0.58 ± 0.12
1350	0.0060 ± 0.0004	0.29 ± 0.13	1.5480 ± 0.0108	0.61 ± 0.33

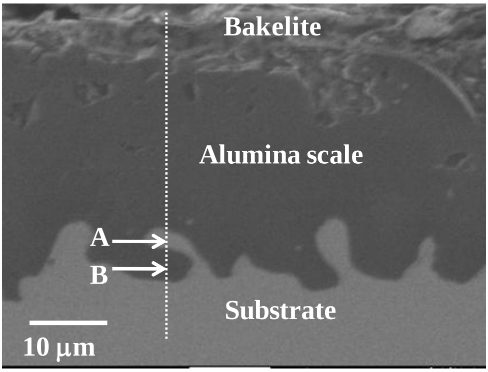

Figure 3: The oxide scale on Pt_{84}:Al_{11}:Cr_3:Ru_2 (at.%) specimen after 200 h exposure time in air at 1350ºC (**Odusote** *et al.*, 2013b)

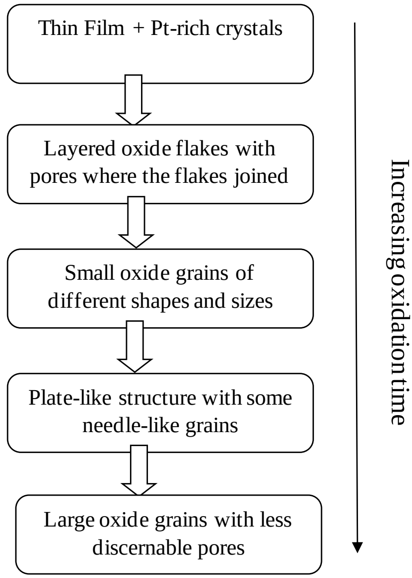

Figure 4: Schematic representation of the progressive development of oxide grains in the α-Al_2O_3 scales on the Pt_{84}:Al_{11}:Cr_3:Ru_2 (at.%) specimens during isothermal oxidation in air between 1150°C-1350°C (**Odusote** *et al.*, 2012b)

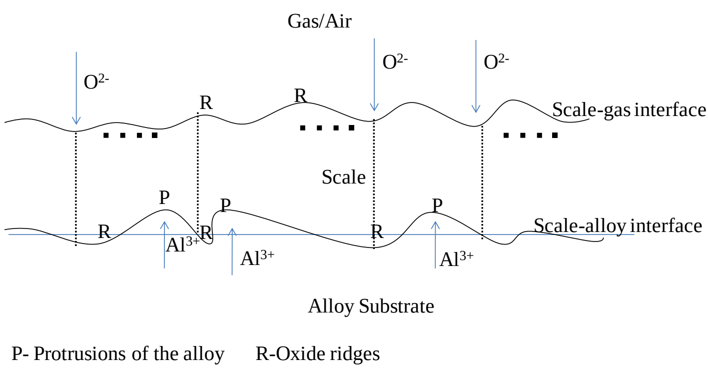

Figure 5: Schematic representation of diffusion-controlled scale growth (**Odusote** *et al.*, 2012b)

Composites: The Future Unveiled

My own work has ventured into the realm of composites, where I have witnessed firsthand the transformative power of these materials. Composites offer strength, lightweight properties, and adaptability that can revolutionize industries. Biodegradable fibres derived from natural plants offers a compelling example of innovation in the realm of composites, particularly in the context of prosthetic sockets.

Vice-Chancellor sir, allow me to introduce an inspiring example of materials innovation that has the potential to reshape the way we think about composites. Bio-implants are materials used to restore or replace injured or damaged body parts or tissue. Development of appropriate biomaterials especially from natural source is critical to achieve this innovation. **Odusote** and Oyewo (2016) developed fibre reinforced polymer composites for application as a prosthetic socket from pineapple leaf and banana pseudo stem as shown in Figure 6. They used biodegradable fibres derived from natural plants, which were once considered waste to fabricate the composite materials and investigated their mechanical properties as possible alternatives to conventional materials, such as the glass fibre reinforced prosthetic socket used in above-knee amputations. In this research, continuous pineapple leaf fibres were treated with sodium hydroxide and acetic acid, unlocking their potential as reinforcing agents. These treated fibres were then impregnated into epoxy and polyester matrixes at varying fibre loadings, ranging from 0% to 50%, using the hand lay-up method. The significance of this work exemplifies the essence of sustainability and resourcefulness. We were not only seeking innovative solutions but also addressing environmental concerns by utilizing abundantly available, yet often overlooked, resources. The results of this study reveal a promising future for biodegradable composites. When compared to the mechanical properties of the glass fibre polyester composite (GFPC), pineapple leaf fibre polyester composites (PLPC) and pineapple leaf epoxy composites (PLEC) demonstrate their potential. It is noteworthy that PLEC, particularly at a 40% fibre loading, exhibits superior mechanical properties when compared to both GFPC and PLPC. The tensile, flexural, and impact strengths of PLEC stand at impressive values of 76.47±3.85 MPa, 81.27±1.77 MPa, and 59.03±0.99 k/Jm², respectively. These values outperform those of PLPC, which achieves tensile, flexural, and impact strengths of 62.09±4.47 MPa, 53.02±1.20 MPa, and 45.22±1.10 k/Jm², respectively. Even in comparison to the conventional GFPC, PLEC shows its mettle, with tensile, flexural, and impact strengths at 59.03±0.99 MPa, 66.10±1.88 MPa, and 52.48±1.77 k/Jm², respectively. These findings open doors to new possibilities, suggesting that PLEC could be further developed as a replacement for glass fibre in above-knee prosthetic sockets.

Figure 6: Fibre extracted from: (a) Pineapple leaf (b) Banana Pseudo stem (**Odusote** and Oyewo, 2016)

The research on pineapple leaf fibre composites serves as a shining example of what the future holds for composites in engineering. It demonstrates how sustainable, biodegradable materials can not only match but surpass the mechanical properties of their conventional counterparts. This is not just an innovation in materials; it is a testament to our ability to transform waste into valuable resources.

Mr. Vice-Chancellor, **Odusote** *et al.,* (2019) also carried out a study on the synthesis and characterisation of hydroxyapatite, that can be used to produce dental implants or serve as a replacement for other body hard tissues. In the study, hydroxyapatite was derived from bovine (cow) bone samples (Figure 7) after they were de-fatted and processed to produce calcium carbonate particles measuring less than 250 μm. The results showed that hydroxyapatite can be extracted economically from a natural source such as bovine (animal) bones and can be employed as a restorative biomaterial for dental implants and hard tissue replacement. In another study, **Odusote** *et al.,* (2023) used a novel approach to produce hydroxyapatite from eggshell using wet chemical precipitation technique. The results showed that wet chemical precipitation technique is an effective method for successful synthesizing hydroxyapatite from raw eggshells. The hydroxyapatite produced can be used as dental implant and for hard tissue replacement.

Figure 7: Bovine bone samples: (a) as sourced; (b) washed and cleaned; and (c) pulverized.

Vice-Chancellor sir, another of my research output on composite materials development draws attention to an intriguing aspect of composites that involves sustainability and cost-effectiveness. In recent years, researchers have sought to harness the potential of materials that are often overlooked and discarded as waste. Coconut fibre and wood dust, two such materials, are currently treated as waste, but they hold immense promise as natural reinforcements in polyester matrixes. These materials offer an opportunity to replace synthetic reinforcement materials, which can be expensive and non-renewable.

Omiwale, **Odusote** and Alabi (2017) delved into the effect of coconut fibre and mahogany wood dust fillers as reinforcement in polyester matrix on the tensile properties and hardness of polyester composites. In this study, composite samples were meticulously produced by casting, incorporating

10 wt% of coconut fibre with varying compositions of wood dust ranging from 1 to 15 wt% into the polymer. The findings of this study were remarkable. They demonstrated that the curing time of these composite materials decreased with an increase in fibre and filler loading, showcasing the efficiency of the production process. Moreover, the tensile strength and hardness of these composites exhibited a remarkable improvement with increasing wood dust content, reaching their optimum values at 12 wt% and 5 wt% wood dust compositions, respectively. What this research underscores are the potential for sustainable and cost-effective alternatives to synthetic fibres in composite production. The presence of mahogany wood dust fillers in coconut fibre polyester composites did not only enhance their tensile properties but also increases their hardness values. This opens doors to a more eco-friendly and economically viable approach to composite manufacturing. In a world where environmental sustainability is of paramount importance, studies like these remind us of the untapped potential of seemingly unconventional materials. The combination of coconut fibre and wood dust, readily available and cost-effective, holds the promise of transforming composite production, making it more environmentally friendly and accessible.

Vice-Chancellor sir, I have not confined myself only to the development of polymer matrix composites but have explored other types, especially those that bother on providing sustaining solutions to the energy crises in a developing nation like ours. Thus, part of my research focus is on the development of feedstock for metallurgical applications and energy generation from different types of agro-wastes and/or coal dust. The biomass is usually upgraded through torrefaction or carbonization, followed by agglomeration and briquetting using binders to form solid-fuel.

Odusote and Muraina, (2017), and Muraina, **Odusote** and Adeleke (2017) produced solid fuels from palm kernel shell (PKS) and mesocarp fibre (MF), which are wastes from palm oil production. Cassava Peel (CP) was used as binder for the briquettes. Three different grain sizes; 350 μm, 250 μm and 150 μm of pulverised PKS were mixed with different proportion of MF to produce the fuels, while the mixing ratios used were 90:10, 80:20 and 70:30 of PKS and MF, respectively. For each briquette sample, a 200 kN force was exerted and the waiting time for the briquette to properly form was 120 seconds. The proximate analysis, mechanical properties and combustion characteristics of the solid fuel were examined. The estimated Fixed Carbon Content of the fuel briquettes is between 16.40 and 19.90 %, the higher heating value lies between 17.0121 and 18.1063 kJ/g, while the results of the least durability and water resistance tests showed that the fuels produced are viable enough to be referred to as solid fuel, which can economically be used for domestic and industrial heating.

Exploration/mining, transportation and handling of lean grade coal (major coal reserves in Nigeria) inevitably lead to generation of large volume of slack/coal fines are often discarded as wastes because they are difficult to handle. Processing of wood for usage in different areas of applications leads to generation of voluminous amount of waste (saw dust) which are often disposed in unhealthy ways such as open burning. Rather than felling of trees, wood wastes can be useful as fuel if properly processed for energy generation and Direct Reduced Iron (DRI) production (Adeleke, **Odusote** *et al.,* 2018).

In an attempt to develop useful engineering materials from this waste, Adeleke, **Odusote** *et al.,* (2019b) studied densification of coal fines and mildly torrefied biomass from Teak (*Tectona grandis*) and Melina (*Gmelina aborea*) into composite fuel using pitch, molasses and starch as organic binders. The research on coal fines densification into briquettes is an excellent example of innovation in materials, demonstrating how commonly available organic binders and pretreated biomass can transform waste into valuable feedstock. In our exploration of materials innovation, we often look to the seemingly unconventional sources of transformation. One such source, which might not immediately come to mind when discussing composites, is the coal processing industry. It is an industry that generates millions of tons of fines, particles smaller than 3 mm, often considered as mere waste. These coal fines, seemingly forgotten byproducts, hold a hidden potential to serve as energy and metallurgical operation feedstock. Imagine, taking what was once considered waste and turning it into a valuable resource for energy production and metallurgy. One avenue for realizing this potential is the densification of coal fines into briquettes or pelletized forms. Over the past few decades, various techniques for briquetting have been adopted, but they've faced significant challenges in terms of binder costs and mechanical integrity. However, a recent study has illuminated a promising path forward. Researchers have focused on utilizing commonly available organic binders in combination with pretreated biomass to develop coal fine briquettes. The process involved the initial pretreatment of raw materials under a substantial load of 2 tons, followed by curing the briquettes in an inert environment. These briquettes were then meticulously characterized for their main litmus requirements, which encompass a range of physical properties crucial for their utilisation.

What's truly remarkable is that the research revealed that pitch-molasses bonded briquettes (Figure 8) exhibited superior physical properties and mechanical integrity compared to briquettes produced from individual binders. These briquettes achieved a density ranging from 1.18 to 1.32 g/cm^3, a drop-to-fracture value exceeding 100 times per 2 meters, an impact resistance index well above 6000, a water resistance index of 99%, and a cold crushing strength of 9 MPa. These results clearly surpassed the recommended physical property benchmarks set for briquettes intended for industrial and domestic end use. Moreover, analyses of the proximate, ultimate, and calorific value of these briquettes did not reveal any deterioration; in fact, there was a mild improvement when compared to the raw coal fines. These remarkable physical properties position the pitch-molasses bonded briquettes as an ideal feedstock not only for various industrial processes such as rotary kiln direct reduced iron and COREX iron-making but also as a high-quality fuel for thermal operations.

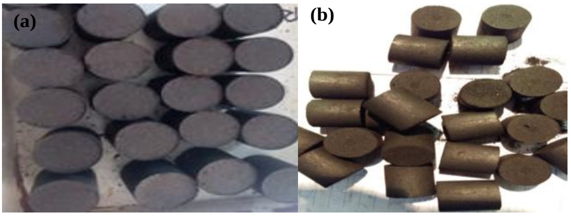

Figure 8: Hybrid fuel briquettes using blended binder (8%pitch-7%molasses); (a) green (b) cured (Adeleke, **Odusote** *et al.*, 2018)

This research is a testament to the transformative power of materials science and engineering, where seemingly ordinary materials and waste can be reimagined as valuable resources through innovation. It reminds us that the future of materials is not confined to traditional sources but can be unearthed in unexpected places, ushering in a new era of sustainability and resource efficiency.

My Contributions to Human, Capital and Infrastructural Development

Vice-Chancellor sir, prior to my appointment as a lecturer in the University of Ilorin, I have worked as a private lesson teacher and public secondary teacher. I have always love teaching since my secondary school days. As a university lecturer/researcher, I have taught and supervised many students in the Materials and Metallurgical Engineering, Mechanical Engineering and Biomedical Engineering Departments. I have supervised over 50 undergraduates, and 15 postgraduates. I have also mentored countless number of students and colleagues. I am proud to state that one of my mentees, Dr. Adekunle Akanni Adeleke, is the current Head, Department of Mechanical Engineering, Nile University Abuja. Dr. Adeleke has consistently made the list of 500 best researchers in Nigeria since 2018 till date. Most of my other mentees are also doing well in public and private universities and polytechnics in Nigeria. I am also happy to state that we have 3 patents from our research outputs and over 85 paper journal articles. I have also served as internal/external examiner for PhD protocols and theses within and outside the University of Ilorin.

Mr. Vice-Chancellor, I have had the privilege to serve the University Community in various capacities. Some of my major community/administrative services include:

A. Services within University of Ilorin:

1. **Dean:** Faculty of Engineering and Technology (August 2023 to Date).
2. **Chairman:** Consortium of Universities in Kwara State (KU8) Maiden Conference Organising Committee (UNILORIN 2023).
3. **Chairman, Publicity Sub-committee:** 1st Faculty of Engineering and Technology International Conference (FETiCON 2023).
4. **Acting Head:** Department of Materials and Metallurgical Engineering **(**2016 – 2018).
5. **Faculty Representative,** Postgraduate School Board (2015 – 2020), Time Table and Room Usage Committee **(**2013 – 2020), and Technical and Entrepreneurship Centre Board **(**2011 – 2013).
6. **Director:** Technical and Entrepreneurship Centre (2018 – 2020).

My service at Technical and Entrepreneurship Centre

Mr. Vice-Chancellor, I will like to put it on record that during the COVID-19 pandemic, the Centre was able to make substantial revenue (**over 17 million naira**) for the University through the production of over 100,000 pieces of ***Hand Sanitizer*** (of different sizes, 100, 150, 200, 500 and 1000 ml) for the Kwara State Government under my leadership. In addition, a limited liability company, TECUIL VENTURE LIMITED was also registered to assist the operation of the Centre. During my tenure, a mini-factory for production of sanitizer and toiletries was established from the fund generated from the Centre, while other existing units such as fashion unit, paint production, graphics, etc, were upgraded and made functional. Substantial amount of money was generated through the Centre into the University coffer.

B. Services outside the University of Ilorin:

1. **Thomas Adewumi University, Oko:** Visiting Dean (January 2023 – date).
2. **Nigerian Metallurgical Society:** Chairman, Local Organising Committee, Annual Conference and General Meeting of (ILORIN 2019).
3. **Nigerian Society of Engineers, National Headquarters, Abuja:** Member, Membership Board (2020 – 2021), Group Dynamics Competition for Branches Committee (2016 – 2018), Prevention, Investigation and Failure Analysis Committee (2015), Nigerian Engineer Magazine Editorial Board Member.
4. **Nigerian Institution of Metallurgical, Mining and Materials Engineers:** National Ex-officio (2019 – 2021)**,** National Vice Chairman (2017 – 2019)**,** National Programme Coordinator (2015 – 2017)**.**
5. **Nigerian Society of Engineers, Ilorin Branch:** Technical Secretary, (2015 – 2017).
6. **Al-Burhan Thrift and Credit Multipurpose Cooperative Society, Unilorin:** Secretary/Loan Committee Chairman, (2015 – Date).

Conclusions

Mr. Vice-Chancellor, in the course of this lecture, I have given an account of my research efforts in the areas of engineering materials development from metals to composites. My research team and I examined the critical roles of engineering materials on innovation and development. One of the important messages in this lecture is that there can never be innovation and technological advancements without the development of appropriate engineering materials. In this lecture, I have also attempted to show that Materials Science and Engineering is a bedrock and critical pillar that interface and connect all modern science and engineering fields. That is, engineering materials is a catalyst for innovation in all facets of our lives, since every product we use in our daily lives is made from a class or combination of classes of materials; metals, polymers, ceramics, biomaterials, etc. From our work, it has been revealed that research and development in the field of materials engineering is greatly influencing the advances in manufacturing technologies, aimed at improving human lives and economy of the nations. Thus, sustained research and development in materials engineering as it related to engineering materials structure, properties, processing and performance are very critical to discovery of new novel materials, devices, and products for the advancement of human and economy of any nation.

As we reflect on the transformative journey from metals to composites, let us remain mindful of the profound impact that engineering materials have had on our past, and the limitless potential they hold for our future. It is through collaboration, innovation, and a commitment to sustainability that we shall continue to unlock the true potential of this remarkable catalyst for progress. The future of engineering materials is a canvas waiting to be painted. Nanomaterials, biomimicry, and smart materials beckon us to explore new frontiers. As we embark on this journey, let us inspire the next generation of scientists and engineers to join us in shaping the future. It is my hope that necessary support will be given to the discipline in order to advance the growth of our nation, Nigeria.

Mr. Vice-Chancellor sir, as we explore the horizons of materials science and engineering, let us remembers that innovation often comes from the most unexpected sources. It is our duty, as scientists and engineers, to push the boundaries of what is possible, to challenge conventions, and to explore the limitless potential of materials in creating a better, more sustainable world. As we move forward, it's imperative that we continue to explore the possibilities that they hold, not only for high-performance applications but also for sustainability.

Thank you for your attention, and I look forward to exciting discussions that will follow.

Recommendations

1. **Value Addition to Locally Available Resources:** Technology has a major role in developing and solving the precarious problem of this nation. It is paramount for researchers to turn attention into developing our local raw materials/minerals resources in providing solutions to the prevailing problem of energy, power, unemployment, insecurity and economic downturn. Engineering raw materials/minerals resources should be processed into valuable products before exportation.
2. **Provision of Adequate Funding and Facilities:** Materials characterisation, processing and development is capital-intensive, because it involved the use of several equipment and machines for testing and evaluation. Thus, there is a need for the Government and Training Institutions to provide adequate facilities for training Materials Engineers at undergraduate and postgraduate levels within the country. There is a need to recognize that a strong materials education is a bedrock for technological advancement and economic development of the nation. Government should enact laws that will mandate manufacturing industries to fund research in area of engineering materials development.
3. **Review Engineering Curricula to Meet the Societal and Industrial Needs:** This is very important in order to make our graduates make-ready and contribution positively to national developments and societal growth.
4. **Revitalization of Ajaokuta Steel Complex and other Metals Company**: Steel and other metal products still remain the major engineering materials for structural applications. Nigeria is a country with a lot of infrastructural deficits and poor industrialization. The government must vigorously pursue the development of the metal sector of the economy in order to reduce the country dependent on imported metal products for her development.

5. **Strong Synergy between Universities and Materials Research Institutes:** There should be co-supervision of engineering materials development related research between academia in universities and research institutes. This synergy will reduce the cost associated with such research and also assist in performance evaluation of the research products. A situation where research institutes engage in research outside their mandates should be discouraged.
6. **Government Ministries, Departments and Parastatals Should be Mandated to Patronise Research Products from Universities and Research Institutes:** This will encourage the development of novel materials for the advancement of human lives and the economy of the nation. The only way to improve our locally developed products is by getting feedbacks from the end-users.
7. **Improved Energy Production and Supply:** Industrial transformation can only thrive on a steady and sustainable supply of energy. This can be achieved by improving the energy mix, since the country is blessed with different materials that can be used to provide energy. This will help to advance the research on the use of biomass and other renewable sources for provision of energy for national economic growth.
8. **Government Should Prioritize Training and Remuneration of Materials Engineers:** There is no area of innovation or technological advancement that will not involve the use of appropriate engineering materials. Scholarships should be made available for postgraduate studies in areas of materials science and engineering as it being practice in most countries of the world, especially the advanced countries. The government needs to provide special fund for the training of Materials/Mining/Metallurgical engineers at all levels, if the country truly wishes to diversify her economy and join the league of Advanced Countries.

9. **Need for Collaboration among the Stakeholders and the End-Users:** Materials Science and Engineering is an inherently interdisciplinary field. It is at the intersection of science and engineering that will find the keys to innovation. Researchers and engineers and materials end-users must collaborate to push the boundaries of what materials can achieve in order to bridge the gap between fundamental research and real-world applications. It is this synergy that will allow us to translate scientific discoveries into technological advancements. As we continue to explore the frontiers of materials science, let us remember the power of collaboration in driving innovation.
10. **Need for Sustainability in Materials Development:** Materials have the potential to address global issues head-on. They can enable cleaner energy production, efficient transportation, and advanced medical treatments. We are tasked with finding solutions to address climate change, healthcare needs, and energy demands. However, the materials of the future must be sustainable, scalable, and environmentally friendly. As researchers and engineers, we hold the keys to unlock these possibilities.

Acknowledgements

First and foremost, my profound gratitude goes to Almighty Allah without whose mercies, grace and support nothing meaningful could be achieved. I thank Him for always being there from me and for making today’s event a reality. Vice-Chancellor Sir, from my humble beginning as an inconsequential child, popularly called “Omo Ilekewu” to getting to the zenith of my profession, I am quite sure that this is a special blessing and test from Allah to see whether I will be grateful or not. O Allah! I am very grateful, Alhamdulilahi, robil alamin. Allah says in the glorious Qur’an (27: 40):

هَٰذَامِنفَضْلِرَبِّلِيَبْلُوَنِيَءَأَشْكُرُأَمْأَكْفُرُ وَمَنشَكَرَفَإِنَّمَايَشْكُرُلِنَفْسِهِ وَمَنكَفَفَإِنَّرَبِّغَنِيٌّكَرِيمٌ

...."this is by the grace of my Lord (Allah) to test me whether I am grateful or ungrateful. And whoever is grateful, it is only for their own good. But whoever is ungrateful, surely my Lord is Self-Sufficient, Most Generous."

I appreciate my first mentor, my late father, Alhaji Maruf Abayomi Abiodun Odusote, whom I wish was alive to witness this occasion. His firmness, boldness, love and discipline have continued to guide us till date. I am very happy that my mother, Alhaja Basirat Oluranti Odusote, is here with us today. May Allah continue to preserve you for us in goodness, sound health and mind, and everlasting happiness and joy, so that you will continue to reap the fruits of your labour. "Iye Gbuyi", "Iye Olohunjeda", "Iye Alfa Jamiu", Alhamdulilahi that you are now "Iye Professor". In shaa Allah, your joy and happiness on me and my other siblings will never cease. Thank you for the love, guidance, encouragements, supports, and above all your regular prayers. Mami, you are one in a million!

I am greatly indebted to all my teachers especially my late Ustaz, Alhaji Mubashir Salman, for the training and support throughout my living with him. May Allah forgives your shortcomings and accept you into Paradise. And to all my teachers at all levels of my education, thank you for assisting me to become what I am today. Specifically, I am sincerely grateful to my supervisors; Prof. L.E. Umoru (B.Sc. OAU), Prof. F.A. Oyawale (M.Sc. UI) and Prof. Lesley Cornish (Ph.D. Wits). I appreciate your guidance and mentorship.

I want to appreciate Professor Ishaq Olanrewaju Oloyede, the current Registrar of JAMB under whose leadership I was employed twice into the University as Assistant Lecturer, and later as Lecturer I in June 2011. I also appreciate all the past Vice-Chancellors, especially Professor Sulyman Agenjolola AbdulKareem under whose leadership I got promoted to the rank of a Professor, and for finding me worthy of being appointed Acting Director, Technical and Entrepreneurship Centre (TEC). I am glad that you were very happy and prayed for me at the end of my tenure. I must appreciate the current Vice-Chancellor, Professor Wahab Olasupo Egbewole, who is my mentor, my supporter and a staunch believer in me, for granting the approval to present this maiden inaugural lecture in the Department of Materials and Metallurgical Engineering. Thank you, sir.

I sincerely want to appreciate my families from both the maternal and paternal sides. From my guardian, my late maternal aunt, Alhaja Rekiat Murtala, who laboured relentlessly on me to have Islamic education and put me in Alfa house, where I lived for about 10 years. How I wish that you are here today, when Alfa Jamiu has become Professor Jamiu. I pray to Allah to forgive you your mistakes and shortcomings, expand your graves, and make our next meeting place Aljanat Firdaos. I deeply appreciate all what you did for me when you were alive. Thank you Alhaja Ganiyat Mosunmola Balogun for putting me in primary school, even when my hand cannot touch my ear, I appreciate your care and love till today. Mrs. Ronke Murtala, Alhaji Taofiq Abimbola Murtala (UK), Mr. Kunle Jeje, all my maternal family members, thank you for the love since my childhood. The Olori-ebi of my paternal family, Alhaji Ligali Odusote and all Odusote family members, home and abroad, thank you for always being there for me. To my siblings and their families, Otunba Tajudeen Odusote, Mrs. Serifat Odusote, Otunba Tola Odusote, Mr. Fatai Odusote, and all others, I appreciate you all.

Special thanks to my in-laws and their families, Late Mr. Mufutau Olowu, Alhaja Ramota Olowu and all her siblings, Alhaja Hamdalat Olowu, Mr. Lekan Olowu, Mrs. Rabiat Olowu and Mr. Azeez Olowu. Thank you to have joyfully given the hand of your daughter/sister to me in marriage, despite the fact that she was still in medical school (300 level) then. I also appreciate all our family and friends including Alhaji and Alhaja Tijani and Family, Mr. Sadiku and family, Alhaji Olarenwaju and family, Alhaji Olowoshile and family. I thank all Al-Burhan cooperative society members and staff, all the staff of Oyins' hospital and my associates and partners. You are all wonderful.

I appreciate alumni members of all my schools; ANSAROSA, As-salisiyah Arabic School, UNIFEMGA, Great Ife, especially MME Class of ’99, University of Ibadan, especially IPEAA M.Sc. Class of 2004, and all my friends and colleagues for their contributions. Thank you all.

I would like to specially appreciate all the past and present academic staff of the Department of Materials and Metallurgical Engineering; from the pioneer HOD of the Department, Prof. A. G. F. Alabi, the immediate past Dean, Faculty of Engineering, Kwara State University, Malete, and all the past HODs, Prof. K.R. Ajao, Prof. J.O. Aweda, Dr. Y.L. Shuaib-babata, Dr. I.I. Ahmed, Dr. R.M. Mahamood (the current HOD), Prof. J.S.O. Adeniyi, Dr. J.A. Adebisi, Dr. S.I. Talabi (my principal personal assistant), Dr. Lanre Busari, Engr. A.N. Aremu, Engr. Yahya Taiwo, Engr. Kabir Ajao, Engr. Ibrahim Ambali, and Engr. James Adegbola, I appreciate you all for your kind support and love always. I would also like to extend my appreciation to all the senior and other colleagues in the Department of Mechanical Engineering, where I actually started my lecturing carrier in the University of Ilorin. It is important to mention, Prof. O.A. Lasode (my pioneer HOD) in the department, and immediate past Dean of the Faculty, from whom I took the mantle of leadership of the Faculty, and Prof. K.R. Ajao, for his warmth reception the first time I met him. I also wish to thank all the past and present non-teaching staff of the Department; Engr. Yahya Abolore, Engr. Awojobi, Mr. Samuel, Mr. Hassan, Mrs. Suliyat Ismail, Mr. Rasaq Ridwan Mrs. Olohunoje, Alhaja Salman, Mrs. Shehaye, Mr. Friday, are all appreciated for your cooperation.

I also wish to appreciate all the academic and non-teaching staff of the Faculty of Engineering and Technology, where I am currently servicing as the Dean. All the past deans, the past and current Sub-deans, the past and current HODs, level advisers, all other academic staff, chief technologists and all other technologists, chief technical staff and all other technical staff, the past and current Faculty officers, all secretarial and administration staff, especially those in the Dean's office, and every member of Engineering family. I thank you all. I want to use this opportunity to remember my late friend and colleague, Prof. M. F. Akorede, may Allah SWT forgive his mistakes and shortcomings and count him among the inhabitant of Aljanat Firdaus. I also want to appreciate the staff of Technical and Entrepreneurship Centre, where I served as Director, for 2 years, you are very wonderful. I enjoyed working with you and thank you for your cooperation.

My professional colleagues in the Nigerian Society of Engineers, especially those in Ilorin Branch, where I had previously served as technical secretary, members of Nigerian Institutions of Metallurgical, Mining and Materials Engineers, and Nigerian Metallurgical Society, I appreciate you all.

I thank my past and present students, distinguished scholars, especially the postgraduate students. I am particularly glad most of them have proved themselves in their various place of work. Mr. Vice-Chancellor, permit me to specially appreciate and thank Dr. Adekunle Akanni Adeleke, my first M.Sc. and Ph.D. student, who is the current Head, Mechanical Engineering Department, Nile University, Abuja. He has consistently won the best researcher of the year Award in Nile University since 2021, and has continued to be among the top 50-200 researchers in Nigeria according to SciVal ratings since year 2020. Dr. Adeleke has published over 90 articles in highly-rated journals and registered three patents since he joined me as M.Sc. student in 2011. Others include Dr. M.O. Ajayi (Lecturer in UK), Dr. S.K. Kolawole, current Head, Department of Mechanical Engineering, Federal polytechnics Offa, Dr. Abideen Oyewo (Lecturer, Osun State University, Osogbo), Dr. Ganiyat Salaudeen (FedPoly, Offa), and many more of them. Special thanks to Mr. Abdulazeez Baruwa, Akeem Azeez, Solomon Iyanda and Ganiyat Odedele. I sincerely appreciate you all.

I appreciate Prof. A.A. Adeoye, the Chairman of Library and Publications Committee, Dr S.I. Talabi, Prof. I.I. Ahmed for the assistance in putting up this manuscript, and all those who assisted me with the editorial of today's lecture. Thank you for the painstaking proofreading and editorial support.

All members of our great Union, ASUU at national, zonal, and branch levels are appreciated for the comradeship. I also want to thank the members of other sister unions, NASU, SSANU, and NAAT who are here and those who could not make it here. Thank you all.

Special thanks to my spiritual leaders: Sheikh Imam Prof. Nasir AbdusSalam, Sheikh Mufutau Ayanbadejo, the Grand Chief Imam of Ijebu land; Imam Sikrullahi Opeyemi Giwa, Chief Imam of Latogun Central Mosque, Ijebu Ode; Imam Mushafau Abdulganiy Odusote, Imam of Onike Mosque, Ijebu Ode; Sheikh Mas'ud K. Ashir, National Chief Missioner Rif'atul Islamiyyah Association of Nigeria, Sheikh Abdulazeez Ayodele Al-yasau, founder of At-taziz Arabic and Islamic Education, Ijebu Ode, Sheikh Idris Abdulkareem, Mudir, Al-Mahir Bil Qur'an Foundation for Quranic memorization and Qiraat, Gerewu, Ilorin; Sheikh Kamoldeen Abiodun Ajijolakewu, Chief Imam of Sanrab Central Mosque, Ilorin. Muslim Community Senior Staff Quarters, main campus, are well appreciated, from our Imam; Prof. Mahfouz Adedimeji, who is the Pioneer Vice Chancellor of Ahman Pategi University, to our Chairman, Prof. Abdullahi Onimisi, Mission Board members, Dr. Ridwan Yusuf, Dr. Imam Tamim, Mr. Misbau Jimoh and the entire Jammah. Jazakum Llahu kyran.

All my political leaders, associates and mentors are well acknowledged; Prof. Y.A. Quadri, Prof. Ayodele Omotosho, Prof. W.O. Egbewole, Prof. A.A. Fawole, Prof. A.A. Adeoye, Prof. U.A. Raheem, Prof. O.A. Omotesho, Prof. K.R. Ajao, Prof. S.F. Ambali, Dr. W.A. Raji, Dr. T.A. Amusa, Dr. M.A. Akanmu, Prof. M.S. Ajao, Alhaji Moruf Akinsemowo, Mr. Adebayo Wahab, and host of others, thank you.

I appreciate my research associates, and collaborators: Dr. A.A. Adeleke, Dr. Peter Ikubani, Prof. O.A. Lasode, Prof. T.B. Asafa, Prof. A.G.F. Alabi, Dr. I.I. Ahmed, Prof. S. Abdulkareem (and all our NRF Award team members), Dr. S.O.

Obayopo, Prof. B.O. Oboirien, University of Johannesburg, South Africa, Dr. H.A. Ajimotokan, and all my past and present students at both undergraduate and postgraduate levels. You are worthy partners, thank you.

I appreciate everybody here today (physically or virtually) and those who cannot make it to this event due to other exigencies of life. Those whom space did not allow me to list and have contributed to my life, please accept my apology, it is not deliberate. I treasure you all.

I cannot appreciate my children enough for their cooperation, understanding and support, in the course of my career advancement. You are blessed and your successes, accomplishments and achievement shall have no bound. Zaynab Oyinkansola, Fatihat Oyindamola, Abdurrahman Oyinlola, and Abdulqayyum Oyindolapo, who is celebrating his birthday with me today. Thank you for making parenting very easy for me and your mother. Allah SWT will continue to preserve you for us in goodness, happiness and joy. I love you all. To the mother of my wonderful children, my confidant, my sweetheart, my adviser, my darling wife, Fatimat Abolanle, you are a wonderful and a very supportive wife. Thank you for making my journey in life stress-free. Thank you for believing in me, even when I am struggling to make ways for myself in life. Thank you for your kindness, generosity, humility, submissiveness and sincere love. Your appreciation is a life-long engagement. I love you now and always.

Vice-Chancellor sir, I began with BismiLlah, kindly allow me to end with these verses from the Glorious Qur'an (Qur'an 37: 179-181) سُبْحَـٰنَ رَبِّكَ رَبِّ ٱلْعِزَّةِ عَمَّا يَصِفُونَ Glorified is your Lord—the Lord of Honour and Power—above what they claim!

وَسَلَـٰمٌ عَلَى لْمُرْ ٱ سَلِينَ Peace be upon the messengers,

وَٱلْحَمْدُ لِلَّهِ رَبِّ ٱلْعَـٰلَمِينَ And praise be to Allah—Lord of all worlds.

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