PRODUCTION OF SOLAR CELL USING AMORPHOUS SILICA OBTAINED FROM RICE HUSK

A RESEARCH PROPOSAL SUBMITTED TO

NATIONAL AGENCYFOR SCIENCE AND ENGINEERING INFRASTRUCTURE (NASENI)

RESEARCH TEAM

1. Principal Investigator

Engr. Sumaila O. Jimoh PhD
Associate Professor/HOD, Department of materials and metallurgical Engineering, Faculty of Engineering, Ambrose Alli University Ekpoma, Edo State, Nigeria.
Email:sumailaarb@gmail.com;
Sumailajimoh@aauekpoma.edu.ng
Phone: 08034151205,
08122703148

2. Supervising Investigator

Prof. S.E Ogbeide
Department of Chemical Engineering, University of Igbinedion, Okada, Edo state
Email: samuelogbeide@gmail.com
ogbeide.samuel@iuokada.edu.ng
Phone: 08037483421

3. Co. – Investigator

Engr. Samuel Igbudu PhD
Associate Professor / Head of Mechanical Engineering Department, Ambrose Alli University, Ekpoma Edo State.
Email: samigbudu.aauekpoma.edu.ng
Phone: 08056519971

a. **Engr. Segun Agbadua**
   Chief Engineer, Fabrication of reactor at NASENI design Institute
   Email: afokhainu@yahoo.com
   Phone: 08036325120

b. **Prof. Rowland Azike**
   Department of chemical Engineering, University of Igbinedion, Okada, Edo state
   Email: azike.ugochukwu@iuokada.edu.ng
   Phone: 08035035446

c. **Mr. Umar Alhaji Salihu**
   Raw Materials research and development council (RMRDC)
   Course: Geology and Mining
   Email: alhajisalihuuar@yahoo.com
   Phone: 07035530356
   08162628980

EXECUTIVE SUMMARY

Solar cell is a device that can convert solar energy into electrical energy. The solar cell is promising because it is environmentally friendly compared to fossil fuel. The essential component in the solar cell is silicon. Silicon is a semiconductor that can absorb sun light. However, the available solar cells currently have relatively high prices because the semiconductor complier material required many processes and expensive. Rice husk ash can be use as producer of environmentally friendly silicon at affordable prices. The rice husk can produce **87.9%** of silica and **16.25%** ash. The silica content of rice husk ash is **94.96%.** The processes for producing silica material as semiconductors include rice husk ash preparation, greying, leaching making silicon by reduction in a reactor conductivity testing. This study will cover the synthesis of silica from rice husk ash using mild novel acid and hydrogen peroxide, analysis of the silica, reduction of silica to silicon in well designed instrumented reactor. The reactor will be designed, instrumented and commissioned using Nigerian experts. The silicon produced will analysed and utilized in the fabrication of solar cells. The solar cell will be utilized to produce solar panels which will be tested for their efficiencies in generating electrical power. The total budget for the research is **₦36,200,000.00** (Thirty six million two hundred thousand naira only) which will cover the cost of field work and samples collection, laboratory work, Process Design and Operation of plant development and results dissemination to prospective investors. The research is expected to be completed in a duration of twenty-four (24) months.

I. Background to Research

Silica is the most abundant compound on earth. Its application spams a wide range of industries. Electronic grade silica is 99.9 percent. The silica must be in the amorphous form. The conventional methods for producing amorphous silica are energy and chemical intensive. These processes are costly and have environmental constraints. There is need for a more economic, low energy and green process for the production of silica. Biomass resources provide alternative feedstock them up in amorphous form for protection and reinforcement The silica found in plants are pure (Laine 2016). Rice husk is a biomass waste that contains about 20% silica. Rice husk is burnt to get rice husk ash (RHA). The production of high purity silica from biomass has been explored by few investigations. The lack of optimized process has limited the engineering applications of the results. The production of pure silicon from rice husk will be characterized with low cost, green and sustainable indicators. The pure silicon from the process will be doped and used in the production of silicon solar cells. This provides a good motivation for this research project.

II. Statement of The Problem

The existing means of producing silica from sand are energy and chemical intensive and generate environmental pollutant carbon dioxide. It is desirable that high purity silica is produced in amorphous form suitable for the production of silicon that will be used in solar cell application. This research will investigate the possibility of producing low cost , high purity silica from silica present in rice husk and reducing the silica to solar grade silicon. The silicon will be utilized in production of solar cell

III. Objectives of the Research

The objectives of the research include the following:

a. Develop a process for the production of silica from rice husk and production of pure grade silicon from the silica.
b. Develop the process to dope the silicon and fabricate silicon solar cells.
c. Design and construct the production facilities.

d. Determine the energy production efficiency of the solar cell.

IV. Research Questions

Is it possible to extract the silica contained in rice husk and reduce the silicon? Is it feasible to dope the silicon and fabricate solar cells from it? What will be the efficiency of electrical energy conversion of these solar cells?

V. Literature Review

Silica is conventionally obtained by mining and purification of quartz. The chemical processing involves the acidification of solutions of sodium silicate. The silica gel is washed and then dehydrated to produce colourless microporous silica (Greenwood et al.). The acidic silica is washed and dried, followed by milling and packaging. The process uses a great deal of energy. The process utilizes chemical that are hazardous and carry a large carbon footprint. Waste water and air emission are high. Alternative silica sources of silica can be processed economically to produce a desired grade of silica. This research will focus on a new process route to synthetize high purity silica from rice husk. Pure silicon will be made from the silica. The silicon will be doped and used in the fabrication of silicon solar cells.

Nigeria is endowed with large solar radiation intensity with an average power of 4.6kwh/m^2. There is the potential to develop energy that uses Sunlight by using solar Cells.

The solar cell is a device that can convert solar energy into electrical energy. The solar cell is more environmentally friendly than fossil energy the solar cell is cleaner and does not have a CO, pollutant It is more renewable because it Can convert to energy to electrical energy. A promising technology is Monocrystalline solar cell.

The essential component of a solar cell is silica or silicone dioxide It is a semiconductor which absorb Sunlight. The existing solar cell has relatively high price because of the Costly processes and costly drafting materials Therefore, it is necessary/ to substitute the Component with component that have the same function at an affordable price

Monocrystalline solar cell is known for its low cost, ability to create in various fields. The essential component of a solar cell is silica or silicone dioxıde. It is a semiconductor which absorbs sunlight. The existing solar cell has relatively high price because of the costly processes and costly drafting materials. Therefore, it is necessary to substitute the component with component that have the same function at an affordable price Rice husks ask is an environmentally friendly silicone producer with high silica content Rice husks burned at 700- 900'C will produce high silica with a rate of 87-97% and ash about 16 - 25%. The silica content of rice husks ash is 94-96% other agricultural feedstock for producing silica include savannah bagasse, sugar can leave bagasse, bamboo leaves, palm ash residues and guinea corn bagasse

These other agricultural residues produce silica with lower yields. The selection of rice husks ash as a raw material for silica is in line with paddy production as a significant food commodity in Nigeria.

The high content silica in rice husk ash is a potential for further processing into semiconductor for monocrystalline solar cells Silica synthesis from rice husks involves the combustion at high temperature, then solubilize with a solvent to remove the non-Silicon component. The non-silicon compounds are removed by leaching with solvents and lastly the downstream process for silica conversion into silicon and purification

Several Investigators (2, 3, 4) have prepared silicon from rice husks Using strong acids like HCI, H,SO,, and H,PO, Their studies explained that the addition of these acids could result in silica yield up to 98,4% The various inorganic acids used in leaching have environmental concerns and can cause health problems Therefore, citric acid contain

carbonyl clusters which can bind to the metal in the rice husk to form complex compound so that silica is produced with a high degree of purity (5)

The oxidation process can be reduced the wet silica to produce silicon

$Si\ (s) + O_{2(g)} \longrightarrow SiO_2(s)$ (1)

The surface is removed by the oxide layer (etching), the surface changes colour to grey.

The etching process serves to give texture to the surface of silicon. The surface structure is formed to increase sunlight absorption at reduce re-reflection. The silicon dioxide reacts with hydrogen fluoride to form Maynesed should be removed and separated in the reaction vessel.

$Si(s) + 2mg\ (g) \longrightarrow Mg_2\ Si\ (s)..$ (2)

The critical parameters for magnesiothermic reduction process include heating rate of 1-4^{oc} /min, reaction temperature of 500 - 900°c, Reduction between 0.5 to 1.2 hours and molar ratio of between 1.5 to 3.

The purification process in which the silicon is converted to silane. The magnesiothermic reduction has been reported to have been used to produce porous silicane structure from silica with a low temperature.

The production reaction of magnesium with silica produce a composite of MgO and silicon

VI. Theoretical Framework

Silicon dioxide is a chemical compound that has been known since ancient times. It is found in nature,existing as a compound of several minerals. It is widely used in process industries. Lately, sources of silica from biomass such as rice husk, bamboo have attracted the interest of investigators. (Shinoharo et al. 2004). Amorphous silica has a wide range of industrial applications. The reaction of silica with sodium oxide produces sodium orthosilicate, sodium silicate and glass. The silicates are insoluble in all polar solvents except methanol. Silica is used for the production of silicon which is the primary constituent in making photocell. The process of producing silicon from silica involves the endothermic reduction in an electric arc furnace (Shriver et al.,2010).

VII. Research Methodology

The feedstock will be collected, dried and stored for use. The basic and detail engineering will be carried out using standard software. Specification sheets will be developed for all process equipment. The equipment will be fabricated, tested for defects and rigged up at the site within the premises of Igbinedion University Okada and federal university Lokoja, Kogi state. The plant will be commissioned. The fabrication and testing of the solar cells will be performed at Akure, where facilities exist. The pilot plant will be operated to attain design capacity.

VIII. Expected Results

The deliverables from the project will include the following:

I. An optimally designed process flow diagram for a pilot plant for the production of high grade silicon from rice husk.

II. Specification sheets for all process equipment.

III. Site and Plant layout drawings

IV. Locally fabricated and test process equipment

V. High grade silicon that will be doped and fabricated to silicon solar cell.

VI. Expertise in fabrication, installation and operation of a process plant.

IX. INNOVATION

The pretreatment of rice husk using citric acid and hydrogen peroxide, the application of response surface method (RSM) to determine optimum process parameters and the design and construction of a pilot plant to produce pure silicon

X. ESTIMATED BUDGET AND FUNDNG REQUIREMENTS (PROVIDE A BUDGET BREAKDOWN BY ACTIVITY/LINE ITEMS)

TABLE 2 SHOWS THE BUDGET ESTIMATE FOR THE PROJECT

S/N	ACTIVITIES	ESTIMATED BUDGET (N)
	LITERATURE REVIEW/RESEARCH MATERIALS	
I	Journals and Journal subscription	1,100,000.00
ii.	Books	1,300,000.00
iii.	Stationeries, writing materials & Photocopy	2,000,000.00
iv.	1 Laptop, Software, CDs	1,100,000.00
	SUB TOTAL	**4,500,000.00**
II	**PROCESS DESIGN**	
i.	Mechanical	500,000.00
ii.	Civil	500,000.00
iii.	Electrical	500,000.00
iv.	Civil Works	500,000.00
v.	Site preparation	1,000,000.00
vi.	Roof and perimeter fence	3,000,000.00
	SUB TOTAL	**6,000,000.00**
III	**DATA COLLECTION**	
i.	Purchase standard equipment	5,000,000.00
ii.	Fabrication	3,000,000.00
iii.	Computer Software for design and Analysis (Licensed copies)	3,000,0000.00
	SUB TOTAL	**11,000,000.00**
IV	Commission of plant and Operator Training	3,000,000.00
VI	Operation of plant characterization/assessment of Solar cell/economic and Environmental Assessment	5,000,000.00
	SUB TOTAL	**8,000,000.00**
VII	**TRAVELS**	
i.	Field Monitoring	500,000.00
ii.	Transport (Planning, Meeting and Data Collection	900,000.00
iii.	Accommodation	300,000.00
	SUB TOTAL	**1,700,000.00**
VIII	**PERSONAL COSTS/ALLOWANCES**	

i.	Principal Researcher	1,000,000.00
ii.	3 Team Member @500,000 per person	1,500,000.00
iii.	2 Researcher Assistants @150,000 per person	300,000.00
iv.	5 Research Informant @150,000 per person	450,000.00
	SUB TOTAL	**3,350,000.00**
X	**REPORTING AND DISSEMINATION (INCLUDING DRAFT AND FINAL REPORTS, PUBLICATION AND CONFERENCE, PRESENTATIONS, STAKEHOLDERS ENGAGEMENT)**	
i.	Advocacy visits to stakeholders and Gate Keepers Research Centre, Abuja.	300,000.00
ii.	Refreshment during planning meeting (10 meetings)	300,000.00
iii.	Five Seminar/Workshop (Transportation, Seminar, Publicity, feel for venue, printing of Seminar materials & Incentive for attendees @100,000 x 5	500,000.00
iv.	Refreshment for 100 seminar attendees, Facilitator Coordinators @80,000 x 5	400,000.00
	SUB TOTAL	**1,500,000.00**
	OTHERS/MISCELLANEOUS CONTINGENCIES	150,000.00
	GRAND TOTAL	**₦36,200,000.00**

XI. PREVIOUS RESEARCH GRANTS BY RESEARCH TEAM

1. Fuel Grade Ethanol from Rice Husk and the Establishment of the Proximate, Ultimate and Compositional Characteristic of Rice Hunks from Nigeria. TETFund Institutional Based Research (2021) N1.8million (Engr. Dr.Jimoh Sumaila – Principal Investigator, Professor S.E. Ogbeie-Co-Investigator)
2. Engr. Dr.Jimoh Sumaila –Principal Investigator postdoctoral fellowship research (2022) N7.8million(Engr. Dr. Jimoh Sumaila –Principal Investigator

XI. WORK PLAN

Activity		Duration							
S/N	TIME (MONTHS)	2month	2month	2month	3month	4month	4month	4month	3month
1	Literature survey								
2	Process Design								
3	Mechanical, Civil and Electrical Design								
4	Civil works(site preparation, roof & perimeter fencing)								
5	Purchase of Standard Equipment/Fabrication								
6	Commission of plant and operator training								
7	Operation of plant/Characterisation /assessment of solar cell								
8	Report Writing								

REFERENCES

Pranowo D. et. Al. (2017), Applications of silica extracted from rice husks Ash for encapsulation of AFB 1 antibody as a matrix in immunoaffinity columns, JSM Mycotoxins, 67, 2, 77 - 83.

Calendar, P. et. Al., (2010), Metal nanopartickes and carbon based nanostructures as advanced materials for cathode application in dye sensitive sensitised solar cells, International j.photoenergy, 1 -5.

Ndububa, E. and Yakubu, N., (2015), Effect of guinea corn husks Ash as partial replacement of cement in concrete, IOSR Journal of mechanical and civil engineering, 12 , 2, 40 - 45.

Life, Y. et. Al. (2009), Effect of rice husks Ash addition on CO2 capture behaviour of calcium based sorbent during calcium looping cycle, Fuel processing technology, 90, 825 - 834.

Agung M. et. Al, (2013), Extraction of silica from rice husks, Konversi, 2,1,28 - 31.

Kuwan, W. H. and Wong, S., (2020), Acid leached rice husks Ash in concrete: A review; Materials Scince Technology, 3 501 - 507.

Kurama , H. et. Al., (2003), Effect of chemical treatment on the production of active silica from rice husks , International mining Congress and exhibition of Turkey, 431 - 435.

Rodriguez-Machin, L. et. Al., Effect of citric acid leaching on the demineralisation and

thermal degradation behaviour of sugarcane trash and bagasse, Biomass bioenergy , 108, 371 - 380.

Chen, j, (2015), Recent developments on silicon based solar cells technologies and their industrial applications, Energy efficiency improvements in smart grid components, intechopen, 271 - 292.

Montgomery, D. C., (2001), Design and Analysis of Experiments, John Wiley and sons, Fifth Edition, New York, USA.

Shinohand, Y. and Kohyama, N. , (2004), Quantitative Analysis of Tridymite in Cristobalite Crystalised in Rice Husk Ash by Heating, Industrial Health, vol.42, pp 277 – 285

Shriver, m. and Atkins, H., (2010), Inorganic Chemistry, W. H. Freeman and Company, 5th Edition, p. 354.

Zemmukhova, L. and Egorov, A., (2006), Properties of Amorphous Silica from Rice and Oat Processing Waste, Organic Materials, vol. 402, pp. 24 – 29.

C. R. Wronski, J. M. Pearce, R. J. Koval, A. S. Ferlauto, R. W. Collins. Progress in Amorphous Silicon Based Solar Cell Technology. RIO 02 – World Climate & Energy Event, Jan 2002, Rio de Janeiro, Brazil. pp.67-72. hal-02120552

S.O. Jimoh, P.S.A Irabor, I. U. Abhulimen, S. O. Amiebenimen (2013). Casting technology and development "Nigeria as a case study" / //International Journal of Scientific & technology research. Vol. 2, Issue 11. – p. 257-260.

O.S. Fakuloju, **S.O. Jimoh,** B.S.O Ighalo (2007). Admixture of using engine oil with (Kerosene) as an alternative fuel for foundry shop / //Advance Material Research.Vol. 18-19. – P. 535-539.

F.I. Apeh, E.O. obadinama, M.E. Ibrahim, **S.O. Jimoh** (2009) Suitability of Lagos Sand for Making Moulds in the Foundry Industries in Nigeria / // journal of Engineering Science and Application. Vol. 6, No 2. – P. 28-36.

S. Zagainov, V. Fillipov, S. Filatov, Y. Gordon, L. Gileva, **S. O. Jimoh,**A. Lozovich (2016). Energy efficient technology to produce hot metal from titania-magnetite ore // AISTech - Iron and Steel Technology Conference Proceedings. Vol. 1, P. 559-566.

Fakolujo, O.S., **Jimoh, S.O.** and Ighalo, B.S.O (2006). Advances in Materials and Systems Technologies. Editited by Selected Peer Reviewed papers from International Conference on Engineering Research and Development Impact on Industry(ICERD).Pp533-539. http//:www.epa.gov/epaoswer/hazwaste/usedoil.htm

Krivandin, V. and Markov, B. (1980). Metallurgical Furnance. 2nd Edition, Mir Publishers Moscow.

Leen Kuiper, burcuEkmekci, Carlo Hamelinck, Willem Hettinga, Sebastian Meyer &KlaasKoop (2007). BioEthanol from Cassava.

Lopez, Y., Garcia, A., Karimi, k., Taherzadeh, M.J., Martin, C., (2010). Chemical characterization and dilute-acid hydrolysis of rice hulls from an artisan mill.BioResources 5(4), 2268-2277.

Nelson, W.L. (1958). Petroleum Refinery engineering. McGraw-Hill, New New.

Srivastava, A.J., Agrawal, P., Rahiman, A., IJIRSET., (2014), Energy Fuels 3, 10187-10194.

Stephan P. & Michael C. (2011). Mult-criteria evaluation of Lligno-cellulosic niche crops for use in bioreffinery processes, nova-institut GmbH Chemiepark Knapsack, Germany. Pp 8-11.

Sues, A., Millati, R., Edebo, l., Taherzadeh, M.J., (2005). Ethanol production from hexoses, pentoses, and dilute-acid hydrolyzate by Mucorindicus. FEMS Yeast Res. 5(6-7), 669-676.

Tabil, L., Kashaninejad, m., Adapa, P., (2011). Biomass feedstock pre-processing-part 1: pre-treatment. INTECH Open Access Publisher.

Taherzadeh, M.J., Karimi, K., (2007). Acid-based hydrolysis processes for ethanol from lignocellulosic materials: a review. BioResources. 2(3), 472-499. www.dprnigeria.com

Wyman, C.E., Dale, B.E., Elander, R.T., Holtzapple, M., Ladisch, M.R., Lee, Y.Y., (2005). Coordinated development of leading biomass pretreatment technologies. Bioresour.

***Jimoh,** S.O. Production of High purity silica from Rice Husk/S.O. Jimoh and S.E. Ogbeide// Impact Factor 3.582 Case Studies Journal ISSN (2305 – 509X) – Volume 9, Issue 12 – Dec – 2020 –P.280 – 287.

Engr. JIMOH O. SUMAILA PhD

CURRICULUM VITAE

ASSOCIATE PROFESSOR OF EXTRACTIVE METALLURGY AND MATERIAL PROCESSING,

FACUTY OF ENGINEERING AND TECHNOLOGY

AMBROSE ALLI UNIVERSITY,EKPOMA

EDO STATE - NIGERIA.

Email: sumailarb@gmail.com

Telephone:+2348034151205; +2348122703148

Name : **JIMOH, SUMAILA OMEIZA**

Post Sought for: Full Professor

Date and Place of Birth: 16TH JULY, 1967/OKENE

Sex: Male

Nationality: NIGERIAN

State of Origin: Kogi

Local Govt. Area: Okene

Home Address: 19 OMOTOYEESTATE ROAD, ORILE-AGEGE, LAGOS STATE. GSM: 08034151205, 08122703148

Present Postal Address: MATERIALS AND METALLURGICAL ENGINEERING DEPARTMENT. P.M.B 14, AMBROSE ALLI UNIVERSITY,EKPOMA, EDO STATE.
E-MAIL ADDRESS: sumailarb@gmail.com

Marital Status: Married

Numbers & 3 Children, 20yrs, 17yrs & 14yrs

Ages of Children

EDUCATIONAL QUALIFICATIONS

INSTITUTION ATTENDED WITH DATES

URAL FEDERAL UNIVERSITY, RUSSIA. 2013-2017

MAGNITOGORSK INSTITUTE OF MINING AND METALLURGICAL ACADEMY, RUSSIA 1992-1993

MAGNITOGORSK INSTITUTE OF MINING AND METALLURGICAL, MAGNITOGORSK, USSR	1985-1990
DONETSK STATE UNIVERSITY, UKRAINE DONETSK.	1984-1985
IHIMA COMMUNITY SECONDARY SCHOOL	1978-1982

QUALIFICATIONS OBTAINED WITH DATES

PhD (Extractive Metallurgy and Materials Engineering)	2017
M.Ph (Operation of Modern Blast Furnace)	1993
M.Sc. (Metallurgy and Materials Engineering)	1990
Higher and Special Secondary Education Certificate (HSC)	1985
West Africa Examination Certificate	1982

PRESENT EMPLOYMENT STATUS AND SALARY

Associate Professor 06 step 3

CONFERENCES/WORKSHOPS/SEMINAR ATTENTED

- The Nigeria Society of Engineers: Metallurgical, Mining and Materials Division: Annual General Meeting/ Conference "LAGOS" 2004 at NBRRI
  Ikoyi, Lagos.
- The Nigeria Society of Engineers: Metallurgical, Mining and Materials Division: The 2004 Materials Distinguished Lecture at Firro, Oshodi, Lagos.

- The Nigeria Society of Engineers: Metallurgical, Mining and Division: The 2006 Distinguished Lecture.

LECTURER:MR. L.K.SHEGAL. Managing Director, Director, Global Infrastructure Holdings (Operators of Ajaokuta and Delta Steel Companies).

TOPIC: "Roadmap for Steel Development in Nigeria. Revitalization of the Nigeria Sector".

VENUE: Sheraton Hotel and Tower Abuja March 9th, 2006.

- 16th "Engineering Assembly", Council for the Regulation of Engineering in Nigeria.
- 2th international conference on research quality leadership and
  Sustainable development in Africa centre for the promotion of international studies and development in association with unimediaP.O.BOX051634, Osu-Accra, Ghana held at the sale audio visuelle, University National Benin, Abomey, Calvary Cotonou, Benin Republic 18th - 21th November 2010.

- 3rd International Conference in Engineering research $ Development (ICER $ D2010) held at university of Benin, Nigeria. 7th - 9th Sept 2010.
- Ceramic Association of Nigeria (CERAN), advancer in ceramic Materials and Technology. Held at post graduate school (Former IDR) Ahmadu Bello University Samaru-Zaria, Kaduna State, Nigeria 6th - 9th October 2010.
- International Scientific Conference in technology research and Engineering held at Ural Federal University, Ekaterinburg Russian Federation, 18th – 20th February, 2014.
- 3rd International Scientific Conference for student Postgraduate and young scientist organized by the Institute of Metallurgy and material science held at Ural Federal University, Ekaterinburg Russian Federation 26th – 29th March, 2014
- 8th International Scientific conference held at Ural Federal University Ekaterinburg Russian Federation 19th -22nd November, 2012.
- 4th International conference on Engineering, Research & Development advances in Engineering, Science & Technology. (ICERD2012) 4th -6th September, 2012. University of Benin, Nigeria.

TEACHING AND PROFESSIONAL EXPERIENCE WITH DATES

- **Magnitogorsk Metallurgical Steel plant, Russia.** 1993-1994

  No.38, Prospect Lenina, Magnitogorsk Iron & Steel Making Unit

  Position Held: Engineer II

- **Magnitogorsk Metallurgical Institute** 1995-1998

  Position Held: **Research Officer 1**

- **NYSC BT Micro experts Limited (**NYSC)1999-2000

  No. 7, Toyin Street, Ikeja, Lagos

- **Yaba College of Technology** School of Engineering, 2003-2005

  Department of Mechanical Engineering, Foundry unit.

  Position Held**: Lecturer I**

- **MATERIALS AND PRODUCTION** Lecturer II 2005-2009

  Engineering Department, Faculty of Engineering and Technology,

  Ambrose Alli University, Ekpoma, Edo State.

- **Industrial and Production** Engineering Department, 2009-2014

  Faculty of Engineering and Technology,

  Ambrose Alli University, Ekpoma, Edo State.

  Position Held: **Lecturer I**

- Department of Iron and Steel Making. 2013- 2014

  Institute of Materials Science and Metallurgy.

  Ural Federal University, Ekaterinburg, Russia Federation.

Position held: **Senior Lecturer**

- **SENIOR LECTURER** 2014-2020

- **ASSOCIATE PROFESSOR** 2020 Till Date

- **Mechanical Engineering Department, College of Engineering, Bells University of Technology, Ota, Ogun State** September, 2022 – June, 2023

Courses Taught: As a Lecturer, I have taught the following courses:-

Course Title	**Course Code**
• Properties of materials	MEE 109
• Foundry Technology	MEE 218
• Materials Processing	MPE 305
• Thermodynamics of Materials System	MPE 307
• Ferrous metallurgy	MPE 409
• Design of Machine Element	MPE 406
• Introduction to Materials Science and Engineering	MPE 211
• Material Science	GEE 212
• Fuel, Furnace and Refractories	MPE 406
• Process and Plant Design	MPE 514
• Mineral Processing	MPE 401
• Physical Metallurgy l	MPE 304
• Project under Graduate Research Supervision	MPE 504
• Metallurgical Thermodynamics of	MPE 603
• Materials Engineering at Post graduate level	
• Metal Forming	MEE 302

- Engineering Metallurgy IPE 303
- Applied Materials Science IPE 631
- Materials Handling TEM 705
- Project Work TEM 714
- Seminar TEM 713
- Building Heat transfer and Air Conditioning BSE 803
- Coordinator: Material Science GEE 203
- Coordinator: Engineering Thermodynamics GEE 205
- Advanced Thermodynamics MEE 805

PAPER PUBLISHED AND CONFERENCE PROCEEDINGS

INTERNATIONAL JOURNALS (TECHNICAL):

1. **Master Theses:** Investigation of the effect of different factors on the high and profile of Cohensive zone of Blast Furnace. (Applicable to Ajaokuta Steel Company). Magnitogorsk State technical University in Russia (Formerly Metallurgical Academy) June 1990.
2. **PhD Theses:** Analysis of possible reduction methods of heat losses during the smelting of Pig iron in Blast Furnace. Ural Federal University, Named after First Russian President Boris Yeltsin, Yekaterinburg, Russia. 31.03.2017.
3. **Jimoh, S.O.** Controlling the peripheral temperature of the blast furnace / S.A. Zagainov, S.V. Filatov, L.Y. Gileva, A.V. Lozovich, S.O. Jimoh // Steel in Translation, Vol. 46, Issue 6, June 2016, p. 378-383.
4. **Jimoh, S.O.**, Energy efficient technology to produce hot metal from titania-magnetite ore / S. Zagainov, V. Fillipov, S. Filatov, Y. Gordon, L. Gileva, S. Jimoh, A. Lozovich // AISTech - Iron and Steel Technology Conference Proceedings. Vol. 1, 2016. P. 559-566.
5. **Jimoh, S.O.**,Analysis of the characteristics of the blast Furnace peripheral zone / S.O. Jimoh, S.A. Zagaynov, C.B. Pyhteeva // International Journal of Scientific & technology research. - 2013. – vol.2, Issue 9. – P. 125-128.
6. **Jimoh, S.O.**, Assessment of Granulometric Composition of Ore Materials and Ore Load on Developmental Regenerative Processes in the Peripheral Zone of the Blast Furnace/ S.O. Jimoh,

S.A. Zagainov, A.V. Lozovich, L.U. Gileva.// International Journal of Metallurgical & Materials Science and Engineering/ Vol. 5. Issue 2. April 2015. p 7-16.

7. **Jimoh, S.O.** Casting technology and development "Nigeria as a case study" / **S.O. Jimoh**, P.S. AIrabor, I. U. Abhulimen, S. O. Amiebenimen/International Journal of Scientific & technology research. – 2013. – Vol. 2, Issue 11. – p. 257-260.
8. **Jimoh, S.O.** Engineering Facilities Information Documentation and Management in Industry Using Autocad / N.N. Ehigiamusoe, **S.O. Jimoh,** J.O. Nordiana, J.O. Igbinoba, U.B. Ehigiamusoe // journal of Engineering and Applied Sciences. – 2008. –No3. – P. 282-289.
9. **Jimoh, S.O.** Admixture of using engine oil with (Kerosene) as an alternative fuel for foundry shop / O.S. Fakuloju, **S.O. Jimoh,** B.S.O Ighalo //Advance Material Research. – 2007. – Vol. 18-19. – P. 535-539.
10. **Jimoh, S.O.** Ceramic Raw Materials Development in Nigeria / P.S. Irabor, **S.O. Jimoh,** O.J. Omowunmi // International Journal of Scientific & technology research. – 2014. – Vol. 3, Issue 9. – P. 275-287.
11. **Jimoh, S.O.**Design and Construction of Melon Shelling and Separating Machine / S.O. Jimoh, M.E. Iribhogbe, E.P. Ohiosimuan // 2nd International Conference on Engineering Research& Development: Innovations (15th – 17th April 2008, Benin City, Nigeria). – 2008. –p. 711-712.
12. **Jimoh, S.O.** Importance of Engineering Materials in Mandate of iron and steel Industry / S.O. Jimoh, U.I. Abhulimen // International Journal of Scientific & technology research. – 2013. – Vol. 2, Issue 12. – P. 47-56.
13. **Jimoh, S.O.** Physical and chemical Analysis of some Nigeria Gypsum Minerals for application in manufacturing Construction and Allied Industries / P.S.A. Irabor, **S.O. Jimoh,** O.J. Omowummi, S.S.J. Ighalo // International Journal Of Scientific & technology Research. – 2013. – Vol. 2, Issue 10. – P. 229-235.
14. **Jimoh, S.O.** Investigation of control opportunities for Thermal performance of the peripheral zone of blast furnace / S.O. Jimoh, A.V. Lozovich, S.A. Zagainov //Izvestiya Ferrous Metallurgy. – 2014. Vol. 59. No. 7, pp.66-67.
15. **Jimoh, S.O.** Investigating the Refractory Property of Jalingo Clay Deposit / S.O. Jimoh, AdamuH.A, Ibrahim M.E, Isa I.K. // International of Scientific & Engineering Research, Volume 9, Issue 2, February – 2018.

16. **Jimoh, S.** O. Capability Assessment of Thermal Control of the Blast Furnace Upper Zone in Peripheral Area/ S. A. Zagainov, S. V. Filator, L. Yu. Gileva, A. V. Lozovich, S. O. Jimoh// Izvestiya – Ferrous Metallurgy. 2016. Vol. 59. No. 6. Pp. 371 – 377.
17. **Jimoh, S.** O. The Developed of Impact Evaluation Methods of Granulometric Composition on Domain Float Indicators// A. V. Lozovich, S. O. Jimoh, S. A. Zagainov// Innovations in material science and metallurgical Materials. III International Interactive Scientific Practical Conference Proceedings. 2013. Pp. 7 – 9,
18. **Jimoh, S.** O. The Effect of Agglomerate Quality on Blast Furnace Indicators // A. V. Lozovich, S. O. Jimoh, S. A. Zagainov // XV International Scientific Technical Ural Scholar – Seminar Material Science – Young Scientist Technology Conference Proceedings 2014, pp. 7 – 9.
19. **Jimoh, S.** O. The Modern Techniques of Manufacturing Black Metals // A. V. Lozovich, S. O. Jimoh, S. A. Zagainov//Innovations in material science and metallurgical Materials. III International Interactive Scientific Practical Conference Proceedings. 2013. Pp. 5 – 6.
20. **Jimoh,** S.O. The Effect of Chromium additions on the Microstructure and some Mechanical Properties of Delta Steel Company Nodular Cast Iron/ S.O. Jimoh and N.N. Ehigiamusoe// International Journal of innovative Research in Electrical, Electronics, Instrumentation and Control Engineering. Vol. 8, issue 9, September 2021 Dol 10.17148/IJIREEICE2020. 8902. –P.9 – 14.
21. **Jimoh,** S.O. Economic Benefit of melting low manganese pig iron/S.O. Jimoh and others// Dol 10.17148/IJIREEICE2020. 8903. –P.15 – 16.
22. **Jimoh,** S.O. Production of High purity silica from Rice Husk/S.O. Jimoh and S.E. Ogbeide// Impact Factor 3.582 Case Studies Journal ISSN (2305 – 509X) – Volume 9, Issue 12 – Dec – 2020 –P.280 – 287.
23. **Jimoh,** S.O. Basic Parametres of Desulpurization process of Metal by Regenerated modern Blast Furnace/ S.O. Jimoh and Zagaynw, S.A// - Volume 9, Issue 12 – Dec – 2020. -.278 – 279.

NATIONAL JOURNALS (TECHNICAL)

24. **Jimoh, S.O.** Determination of Optimum Lump size f Sinter obtained from Itakpe Iron Ore Concentrate as charge material for Blast Furnace / S.O. Jimoh, M.E. Ibrahim, B.S.O. Ighalo //

Nigeria Journal of Engineering in Faculty of Engineering Ahmadu Bello University Zaira. – 2008. – Vol. 14, No 2. – p. 5-7.

25. **Jimoh, S.O.** Ibrahim, E.M. Contemporary Issues and Trends in Engineering Education and Practice in Nigeria / E.M. Ibrahim, **S.O. Jimoh** // Journal of Academics. – 2006. – Vol. 1, No 2. – P. 221-228.
26. **Jimoh, S.O.** Rules in use for building self-diagnostic, adaptive work-system just in Time in practice in Toyota / L. Imaekhai, E. Omokhuale, E. Osawe, **S.O. Jimoh**// A categorical Imperative journals of science and technology research. – 2010. – Vol. 9, No3. – P. 104-117.
27. **Jimoh, S.O.** Suitability of Lagos Sand for Making Moulds in the Foundry Industries in Nigeria / F.I. Apeh, E.O. Obadinama, M.E. Ibrahim, **S.O. Jimoh**// journal of Engineering Science and Application. – 2009. – Vol. 6, No 2. – P. 28-36.
28. **Jimoh,** S.O. Production and Characterization of Asbestor Free Brake Pads from Kenat Fiber composite/Elakhame Z.U, Shuaib – Babata, Y.L, Jimoh, S.O and others. Adeleke University Journal of Engineering and Technology. (AUJET) Vol. 3, No. 1, 69 – 78 (2020).
29. **Jimoh,** S.O. Development of a Horizontal Three Bladed Windmill with Vortex Tubes/ Paul Major, A. S. Adavbiele and S. O. Jimoh// Journal of Advances in Science and Engineering (JASE) 5(2021) 37 – 44.

PROJECT WORK SUPERVISED AT BOTH UNDERGRADUATE AND POSTGRADUATE LEVEL

- Design and Construction of a Mobile Electric Oven
- Design and construction of an Electric Plantain Roaster
- Design and Fabrication of a Portable Gas Cooker
- Design and Fabrication of a Metal Bending Machine
- Design and Fabrication of a Metal Rolling Machine
- Design and Fabrication of a Impact Test Equipment for Brittle Materials
- Design and Fabrication of a Parabolic Solar Cooker
- Design and Fabrication of a Mellon Shelling and Separating Machine

- Production and characterization of Asbestos free Break pads from kenaf fiber composite; MSc. Co-Supervisor
- Development of a horizontal three bladed wind mill with vortex tubes; MSc. Co-Supervisor
- Development of an Integrated Model for Bottle neck management in manufacturing Industry; PhD Co-Supervisor

ADMINISTRATIVE EXPERIENCE/RESPONSIBILITIES

- Teaching, Research and Development of Department.
- Supervision of Students Training (I.T.).
- 500 Level Class coordinator 2005/2006 sessions; 2007/2008 Session;
  2008/2009 session and 2009/2010 session respectively.
- Foundation programme Co-coordinator 2005/2006 Session; 2006/2007 Session.
- Examination Officer for 2006/2007 Session; 2007/2008 Session; 2008/2009 Session; 2016/2017 and 2017/2018 respectively.
- Chairman NUC accreditation committee for the department 2007/2008 till 2011/2012 session respectively.
- Appointment as the School of Postgraduate Studies representative on the Oral Examination Panel in respect of Master Student Candidate (21st of June, 2017).
- Appointment as the School of Postgraduate Studies representative on the Oral Examination Panel in respect of Master Student Candidate (5th of |April, 2018).
- Appointment as a Member of the Curriculum Drafting Committee in the Department of Industrial and Production Engineering for the 2016/2017 and 2017/2018 academic Session.
- Appointment as a Member of the Accreditation Committee in the Department of Industrial and Production Engineering for the 2016/2017 and 2017/2018 academic Session.
- Appointment as a reviewer to journal of advances in Science and Engineering, Department of Electrical and Electronic Engineering, Faculty of Engineering and Technology, Ambrose Alli University, Ekpoma Edo State.
- Appointment as Examination Officer in the Department of Industrial and Production Engineering for the 2018/2019 Academic Session.

- 3rd World congress &Expo on Biotechnology and Bioengineering and Nanotechnology& Material science. September 02-03, 2019 Dubai.
- UAE Title: Mathematical model for controlling the peripheral zone Temperature of the blast furnace
- 29th Engineering Assembly Theme: Advancing the frontiers Engineering Practitioners and Entrenching Professionalism for National Development.
- INTERNATIONAL CONFERENCE CENTRE (ICC), ABUJA Monday 9th –Wednesday 11th August, 2021
- COREN OBE REGIONAL WORKSHOP ON IMPLEMENTATION OF OUTCOME-BASED EDUCATION IN THE UIVERSITIES HELD AT UNIVERSITY OF BENIN, BENIN-CITY DATE: OCTOBER, 11th – 14th, 2021
- Implementation of outcome Based Education (OBE) process in Accreditation of Engineering programmes in Nigerian Universities. Held at Council Chambers, COREN Headquarters, Abuja. on Thursday 22nd – Friday 23rd August, 2019.
- Associate Examiner, Materials and Metallurgical Engineering for COREN Professional Interview held at National Centre for Women Development, Tafawa Balewa Street, Central Business District, Abuja on 25th to 30th of October 2021.
- Attended the 35th Annual Conference &AGM from 30th October-2nd November, 2019 held at main auditorium. University of Ilorin, Ilorin, Kwara State, Nigeria. Theme of the conference "Role of Metallurgical Industries in Sustainable Development Goals"
- Appointment as coordinator, Department of Materials and Metallurgical Engineering for the 2018/2019 Session.
- Appointment as Head of Industrial and Production Engineering Department from 2019 to 2020.
- Appointment as Head of Materials and Metallurgical Engineering Department from 2021 to January, 2022
- Chairman of Accreditation committee NUC/COREN 2022 – 2023 Section, Department of Mechanical Engineering Bells University of Technology, Ota, Ogun State.
- College Examination Supervision Board of Studies team Member ; 30/01/2023
- College Examination Supervision Board of studies team member ; 24/03/2023

- PhD Seminar for AJAYI Sunday Thomas (2016/5503) and SALAMI Habeeb Abiodun (2016/5520) Reviewed at Department of Mechanical Engineering on February 15, 2023.
- PhD Seminar for Innocent Oko (2019/0487) and Dauda Anthony Ehinomhen (2021/0581) Reviewed at Department of Mechanical Engineering on February 6, 2023.

MEMBERSHIP OF PROFSSIONAL BODIES

- Registered by the council for The Regulation of Engineering in Nigeria, COREN: (R,27,199).
- Corporate member of Nigeria society of Engineers. (NSE).
- Corporate member of Metallurgical, Materials and Mining Diversion (MMMD / NSE).
- Corporate member, Nigerian Metallurgical Society (NMS).
    - Research Grants And Other Grants (Specify Amounts)
    - Tertiary education trust fund academic staff training and development for overseas training scholarship awards (TETFUND), PhD Programme.
    - Best Paper Awards: Assessment Of Granulometric Composition Of Ore Materials And Ore Load On Developmental Regenerative Processes In The Peripheral Zone Of The Blast Furnace.

RESEARCH IN PROGRESS:

On-going Research:

(1) Investigation of the effect of different factors on the high and profile of cohesive zone of blast furnace. (Applicable to Ajaokuta Steel Company)

(2) Development of Calcium-Treated Nodular cast Iron.

(3) Fuel Grade Ethanol from rice husk

(4) Production of solar cell using amorphous silica obtained from rice husk

ANY PHYSICAL CHALLENGE?

No

REFEREES:

- **PROF. S.D MUSA**

  DVC ACADEMIC, FEDERAL UNIVERSITY LOKOJA

  Tel: 08035955767

- **ENGR. PROF. O. OBODEH**

  Department of Mechanical Engineering

  Faculty of Engineering and Technology,

  Ambrose Alli University, Ekpoma

  Tel: 08035462460

  Email:engobodeh@yahoo.com

- **PROF OGBEIDE S.E.**

  Department of Chemical and Petroleum Engineering,

  Igbinedion University, Okada, Edo State.

  E-mail: Samuelogbeide@gmail.com

  Tel: 08037483421