Curriculum Vitae

LEELA MANOHAR AESHALA

Assistant Profesor (Grade-I), Department of Chemical Engineering
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Professional preparation

- **Indian Institute of Technology Guwahati, Ph.D., 2010-2014**
  - Scored CGPA 9.0 in course work, Chemical Engineering
  - Studies on solid polymer electrolyte for electrochemical reduction of carbon dioxide
- **Andhra University college of Engineering, M.Tech, Visakhapatnam, 2007-2009**
  - Scored first class with distinction (CGPA 8.62), Chemical Engineering
  - Obtained class first rank
  - Design of experiments on fuel cell stack
- **Jawaharlal Nehru Technological University, Anantapur, B.Tech, 2003-2007**
  - Scored first class (67.92%), Chemical Engineering
- **M.N.R. Junior College, Hyderabad, Intermediate, 2001-2003**
  - Scored first class (93.5%),
  - Maths, Physics, Chemistry
- **A.P. Residential School, Sarvail, S.S.C., 2000-2001**
  - Scored first class (91.2%)

Academic Experience

- Assistant Professor, Department of Chemical Engineering 14.12.2015 – 13.12.2020
  National Institute of Technology Hamirpur.
- Assistant Professor, Department of Chemical Engineering 21.07.2014 - 11.12.2015
  National Institute of Technology Agartala

Notable Sponsored Projects

- Title: "Development of Amine Functionalized Polymer Electrolytes for Reduction of CO_2 to Fuel"
  Funding agency: Science and Engineering Research Board Duration: 2017-2020

The project cost: 35,42,000/- Scheme: Early Career Research Award. I have trained two junior research fellows, one Ph.D., three Post graduate students and six undergraduate project groups.

Papers published in peer reviewed international journals

- Kumar, A., Aeshala, L.M., "Imidazolium functionalized polymers for effective electrochemical reduction of CO_2" Journal of Polymer Engineering, 2020, 41, 3. (Degruyter Publication)
- Aeshala, L.M., Verma, A., "Amines as Reaction Environment Regulator for CO_2 Electrochemical Reduction to CH_4", Macromolecular Symposia, 2015, 357 (1), 79-85. (Wiley Publication).
- Aeshala, L.M., Uppaluri, R.G., Verma, A., "Electrochemical Conversion of CO_2 to Fuels: Tuning of Reaction Zone using Suitable Functional Group in Solid Polymer Electrolyte", Physical Chemistry Chemical Physics, 2014, 16, 17588-17594 (RSC Publication).
- Aeshala, L.M., Uppaluri, R.G., Verma, A., "Effect of Cationic and Anionic Solid Polymer Electrolyte on Direct Electrochemical Reduction of Gaseous CO_2 to Fuel", Journal of CO_2 Utilization, 2013, 3-4, 49-55 (Elsevier Publication).
- Aeshala, L.M., Rahman, S.U., Verma, A., "Effect of Solid Polymer electrolyte on Electrochemical Reduction of CO_2 to Fuel", Separation and Purification and Technology, 2012, 94, 131-137 (Elsevier Publication).
- Singh, S., Aeshala, L.M., Verma, A., "Sustainable Production of Fuel from Electrochemical Reduction of Carbon Dioxide" International Journal of Innovative Research and Development, 2012, 1(7), 155-160 (IJIRD Publication).
- Aeshala, L.M., Rahman, S.U., Verma, A., "Development of a Reactor for Continuous Electrochemical Reduction of CO_2 using Solid Electrolyte, ASME Proceedings, ES 2011, 1193-1199 (ASME Publication).

Papers in international conferences

1. Nitin Dalve, Abhsihek Kumar, **Aeshala, L.M.,** Effect of imine based functional group on electrochemical reduction of carbon dioxide, 26th International symposium on chemical reaction engineering & 9th Asia pacific chemical reaction engineering symposium, IIT Delhi, 6-9 December 2020 (accepted as poster presentation).
2. Manju Rawat, **Aeshala, L.M.**, Amine Functionalized Polymer Electrolytes for Electrochemical Reduction of CO_2 to CO and CH_4, International Conference on Surface Engineering, IISc Bangalore, 9-11 August, 2018.

3. **Aeshala, L.M.,** Verma, A., Selective Formation of CH_4 from Electroreduction of CO_2 using Amine Based Solid Polymer Electrolytes as Reaction Zone Regulator, International Conference on NanoTechnology (ICNT-2015), 19-22 February, 2015, Haldia Institute of Technology, Haldia, India
4. **Aeshala, L.M.**, Verma, A.*, International Conference on Soft Materials, 06-10 October, 2014, MNIT, Jaipur, India.
5. **Aeshala, L.M.**, Verma, A.*, International Conference on Environmental Technology and Sustainable Developments: Challenge and Remedies, 21-23 February, 2014, Lucknow, India.
6. **Aeshala, L.M.***, Rapally, R., Verma, A., International Conferences on Harnessing Natural Resources for Sustainable Development, 29-31 January, 2014, Cotton college, Guwahati, Assam, India.
7. Singh, S., **Aeshala, L.M.***, Verma, A., International Seminar and Workshop on Energy Sustainability and Development, 12-14 October, 2012, Sibsagar, Assam, India.
8. **Aeshala, L.M.***, Rahman, S.U., Verma, A., International Conference on Recent Advance in Chemical Engineering and Technology (RACET), IIChE, 10-12 March, 2011, Kochi, India.
9. **Aeshala, L.M.**, Rahman, S.U., Verma, A.*, Proceedings of the 5th International Conference on Energy Sustainability, 7-10 August, 2011, Washington DC, USA.

Papers in national conferences:

1. Rahul, B., Movin, S., Radhika, B., Arjun, M., Aeshala, L.M.*, Kinetic Model for Electrochemical reduction of Aqueous CO_2 at Cu Electrode, CHEMCON-2019, 27-30 December 2019, NIT Jalandhar, India
2. Manju Rawat, **Aeshala, L.M.**, Electrochemical Reduction of CO_2: Present status, Future Aspects, RTCSE-2017, 13-14 October 2017, NIT Hamirpur.
3. **Aeshala, L.M.***, Rapally, R., Verma, A., Reflux- Annual Chemical Engineering Symposium, 29-30 March, 2014, IIT Guwahati, Guwahati, India.
4. **Aeshala, L.M.**, Yadav, S.K., Uppaluri, R.G., Verma, A.*, Seminar on Carbon Management for Sustainable Development, Institute of Engineers, 14-16 November, 2013, Duliajan, Assam.
5. **Aeshala, L.M.***, Verma, A., REFLUX-2013, A Technical Annual Meeting, Department of Chemical Engineering, 3-4 April, 2013, IIT Guwahati, Assam.
6. Ghosh, A., **Aeshala, L.M.***, Verma, A., CHEMCON-2012, 65th Annual Meeting of Indian Institute of Chemical Engineers, 27-30 December, 2012, NIT Jalandhar, Punjab.

7. **Aeshala, L.M.***, Rahman, S.U., Verma, A., CHEMCON-2012, 65th Annual Meeting of Indian Institute of Chemical Engineers, 27-30 December, 2012, NIT Jalandhar, Punjab.
8. **Aeshala, L.M.***, Rahman, S.U., Verma, A., CHEMCON-2011, 64th Annual Meeting of Indian Institute of Chemical Engineers, 27-29 December, 2011, Bangalore.

Book published .

1. Leela Manohar Aeshala and Anil Verma, "Electrochemical Reduction of CO_2 to Value Added Products: Role of Solid Electrolyte ", Scholars' Press, Germany, (2015), (ISBN-13: 978-3-639-76153-5; ISBN-10: 3639761537).

Awards:

- **Best poster award (3rd prize)** has been conferred to the paper entitled as "Electrochemical Reduction of Atmospheric CO_2 to Generate Fuel and Simultaneous Storage of Solar Energy", held at Reflux-Chemical Engineering Annual Symposium, 29-30 March, 2014, IIT Guwahati, Guwahati, India.
- Secured **2nd** prize in **exhibition competition** to the concept entitled as "Electrochemical Reduction of CO_2 using Solar Energy and Developed Electrochemical Reactor", held at Reflux-Chemical Engineering Annual Symposium, 29-30 March, 2014, IIT Guwahati, Guwahati, India.
- Secured **2nd** prize in **Green-Tech competition** to the topic entitled as "Solar Energy Driven Electrochemical Reduction of CO_2 for Generation of Renewable Fuel", held at Reflux-Chemical Engineering Annual Symposium, 29-30 March, 2014, IIT Guwahati, Guwahati, India.
- **Best poster award** has been conferred to the paper entitled as "Effect of Solid Electrolyte on Electrochemical Reduction of CO_2 to Generate Fuel", held at International conference on environmental technology and sustainable developments: challenge and remedies, 21-23 February, 2014, Lucknow, India.
- **Best paper award** has been conferred to the paper entitled as "Electrochemical Reduction of CO_2 using Solid Polymer Electrolyte Reactor", in Transport Phenomenon Session held at International conference on Recent advance in chemical engineering and technology (RACET), IIChE, 10-12 March, 2011, Kochi, India.

Course/workshop organized:

- **GIAN** course has been organized on "**Emerging Electrical Energy Storage Applications**" during 11-16 December 2017 as a Course Coordinator at Department of Chemical Engineering, NIT Hamirpur. Foreign faculty: Prof. A.M. Kannan from Arizona state university, USA.

- Workshop has been organized on **"Industry Institute Interaction Programme**" as workshop coordinator held at Department of Chemical Engineering, NIT Hamirpur during 21-22 October, 2016,
- Workshop on "**ASPEN for chemical engineers**" held at Department of Chemical Engineering, NIT Hamirpur during 20-21st February, 2016.

Course/workshop attended:

- GIAN Course on "Chemical, Biochemical and Environmental Issues related to Cancer Solutions Addressing Problems", 11-16 September 2017, NIT Hamirpur.
- GIAN Course on "Advanced Nanomaterials: Applications in Disease Diagnosis and Imaging", May 29 - June 3, 2016, NIT Hamirpur.
- Workshop on "Industry Institute Interaction Programme", 05-06 March 2016, NIT Jalandhar, India.
- International Conference and Workshop on Green Energy and sustainability Development, 12-14 October, 2012, Sibsagar, Assam, India.
- Workshop on "Engineering Problem Solving Using MATLAB" held at G.V.P. College of Engineering, Visakhapatnam, Andhra Pradesh, India.
- Workshop on "Fuel Cell Technology–2008" held at Department of Chemical Engineering, College of Engineering, Andhra University, Andhra Pradesh, India.
- Workshop on "Advanced Methods for Data Processing and Parametric Estimation in Chemical Processes" held at Department of Chemical Engineering, College of Engineering, Andhra University, Andhra Pradesh, India.

Courses Taught:

Theory Courses:

- Mass Transfer –I
- Mass Transfer-II
- Chemical Reaction Engineering-I
- Chemical Reaction Engineering-II
- Polymer Science and Engineering
- Heterogeneous Catalysis and Catalytic Processes
- Fuel Cells and Hydrogen Energy

Laboratory Courses:

1. Chemical Reaction Engineering Laboratory

2. Mass Transfer Laboratory
3. Instrument and Analysis Laboratory
4. Numerical Methods for Chemical Engineering Laboratory
5. Process Equipment Design Laboratory
6. Mechanical Operations Laboratory

Administrative experience:

1. Assistant Faculty In-charge (Admissions & Registrations), NIT Hamirpur
2. Assistant Warden, Himgiri Hostel, NIT Hamirpur
3. Mentor, NIMBUS, Technical Fest, Department of Chemical Engineering, NIT Hamirpur.
4. Assistant Co-ordinator, Training and Placement Cell, NIT Agartala.
5. Assistant Warden, Aryabhatta Hostel, NIT Agartala.

Department Activities:

1. Convener, DMPC, Department of Chemical Engineering, NIT Hamirpur
2. Member, DBPC & DDPC, Department of Chemical Engineering, NIT Hamirpur
3. OIC, Mass Transfer Lab
4. OIC, Chemical Reaction Engineering Lab
5. OIC, Purchase, Department of Chemical Engineering, NIT Hamirpur
6. Coordinator, IIChE student Chapter at Department of Chemical Engineering, NIT Hamirpur
7. Member, DUGC at Department of Chemical Engineering, NIT Agartala.
8. OIC, Infrastructure

Expert talks:

- Delivered Invited talk on "**Electrochemical Carbon Dioxide Reduction to Green fuel: Problems and Prospects**" for Advances in Sustainable Thermal Energy Systems: Theory and Computation (ASTESTC-2020) organized by Department of Mechanical Engineering at NIT Hamirpur, India.
- Delivered Invited talk on "**Pollution Control & Safety Aspects in Industries**" for Skill India Program on Industrial Safety and Hazard Management-2018 organized by Department of Chemical Engineering at NIT Hamirpur, India.

- Delivered invited talk on **"Solid Polymer Electrolytes for Electrochemical Reduction of Carbon Dioxide**" at Next Generation Clean Fuels, Growdiesel, 17-18 September, 2013, New Delhi, India.

References:

Dr. Anil Verma
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Department of Chemical Engineering,
Indian Institute of Technology Delhi,
New Delhi-110016, India.
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Prof. Suggala V. Satyanarayana
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JNT University Anantapur, Anantapuramu,
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Prof. A.M. Kannan,
Professor, The Polytechnic School
Ira A. Fulton Schools of Engineering, PRLTA 335A
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Mesa, AZ 85212
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Students Guided:

Ph.D.:

Mr. Abhishek Kumar worked on development of amine functionalized electrolytes for reduction of CO_2 to Fuel (worked for one and half year under my supervision)

PG Dissertation:

Sl. No.	Title of Dissertation/Project	Department/ Institute	Name of student[s]	Year
1	Effect of imine functionalized polymer electrolyte for reduction of CO_2 -	Chemical Engineering, NIT Hamirpur	Nitin Dalve	June 2020
2	Development of Reactor for Electrochemical Reduction of CO_2	Chemical Engineering, NIT Hamirpur	S.V. Chinna Naik	June 2020
3	Development of Amine based electrolyte for CO_2 reduction to fuel	Chemical Engineering, NIT Hamirpur	Manmohan Jangra	June 2020

UG Project

Sl. No.	Title of Dissertation/Project	Department/ Institute	Name of student[s]	Year
1	Kinetic Model for Electrochemical Reduction of Carbon Diozide at Copper Electrode	Chemical Engineering, NIT Hamirpur	Movin Sharma, Radhika Bagaria, Rahul Bhatti	May, 2019
2	Synthesis of Catalyst for Electrochemical CO_2 reduction	Chemical Engineering, NIT Hamirpur	Arjun Malhotra, Dharmendra Gautam, Ravi Kumar	May, 2019
3	Solid Polymer Electrolyte for Electrochemical Reduction of CO_2	Chemical Engineering, NIT Hamirpur	Lokesh Surana, Vikas Kumar, Mahendra Meena, Chandra Prakash	May, 2019
4	Development of Solid Polymer Electrolyte For the Conversion of CO_2 to Fuel	Chemical Engineering, NIT Hamirpur	Navadeep Sharma, Rachita Sharma, Chaman	May, 2018
5	Development of Solid Polymer Electrolyte For the Conversion of CO_2 to Fuel	Chemical Engineering, NIT Hamirpur	Manu Thakur, Jati Dogra, Manu Thakur, Manish Kumar, Vasu Nath	May, 2018
6	Development of Membrane Reactor for Removal of Lead ions from water	Chemical Engineering. NIT Hamirpur	Nirdosh Gupta, Anupam Dhiman, Ajaya Poonia, Ashish Thakur, Radhika Modi	May 2017
7	Electrochemical Reduction of CO_2 into Methanol Using Cu/Cu2O Electrodes in $NaHCO_3$ solution	Chemical Engineering, NIT Agartala	Abhishek Kumar, Alajangi Venkatesh	May 2014

Summary of Research Experience:

PhD Thesis Title: 'Studies on Solid Polymer Electrolytes for Direct Electrochemical Reduction of CO_2 to Fuel''

Electrochemical reduction of CO_2 (ERC) has attracted great attention for its several advantages: reduce the CO_2 concentration from the atmosphere, electricity used to drive the process using renewable energy sources, storage of renewable energy (e.g., solar energy) in the form of liquid or gaseous reaction product(s), generation of fuel/hydrocarbons. In this study, various solid polymer electrolytes were synthesized and characterized for the direct electrochemical reduction of CO_2 and particularly the role of SPE in dERC was investigated. Moreover, cationic and anionic exchange SPEs, functional groups and the reaction zone tuning by the modification of functional groups in SPE were studied and evaluated for dERC. The main findings emanating from this study are summarized ahead. The work was focused on the development of an electrochemical reactor for continuous electrochemical reduction of carbon dioxide in gas phase using solid polymer electrolytes. Cationic (nafion and SPEEK) and anionic (alkali doped PVA/GA and Amberlyst/SPEEK) solid polymer electrolyte membranes were synthesized by casting method. The synthesized membranes were extensively characterized by SEM, TGA, XRD, FTIR, water uptake, swelling, ion exchange capacity, ionic conductivity, and tensile strength. The anode and cathode were prepared using Pt/C and copper electrocatalysts, respectively to form a membrane electrode assembly. The reactor was developed successfully and the preliminary study shows encouraging results for continuous gas phase CO_2 electroreduction in different solid electrolyte environment. The role of cationic and anionic SPE on the direct electrochemical reduction of gaseous CO_2 has been emphasized. The CMI-7000 and AMI-7001 were procured and successfully treated with H_2SO_4 and KOH, respectively, to get protonic and hydroxyl ion conductivity. Both the SPEs were characterized using ex-situ methods. The maximum Faradaic efficiency obtained for CH_4 formation was 32% at 2.5 V. The Faradaic efficiencies for C_2H_4 and CH_3OH were about 15% and 19%, respectively, at 2 V. The probable reason may be the electrostatically attracted quaternary ammonium ion of the AMI-7001 to the negative cathode and thus assisting the electron flow from cathode to the CO_2 in the electrolysis. However, anionic sulfonic group of CMI-7000, which might hardly be adsorbed onto the cathode due to the electrostatic repulsion at the negative cathode and thus caused hindrance to the flow of electron to CO_2 during electrolysis. It may be concluded that quaternary ammonium group in anionic SPE played major role in the activation of CO_2 and thus enhanced the efficiency of the dERC. It has been observed that though the functional groups are important for the rate of reaction but the polymer backbone, which infact does not take part in the reaction influences the reaction indirectly. Therefore, with this information, we have conceptualized the idea of active reaction zone and thought that it would be possible to change the reaction products by changing the surroundings of the functional group, while keeping all the other

parameters fixed. The anionic SPE (PEI/PVA/KOH and QPEI/PVA/KOH) membranes were successfully prepared and characterized. The conceptual reaction mechanism was successfully proposed. It was found that the anionic solid polymer electrolyte with suitable functional groups played an important role to enhance direct electrochemical reduction of CO_2. It was seen that the reaction zone can be tuned by the modification of functional groups for selective formation of products for dERC. Moreover, the developed solid polymer electrolyte showed higher electrochemical reduction of CO_2 and greater suppression of H_2 evolution. Thus the study fulfills the aim of the research work along with the objective. It may be noted that though the selectivity of the products increased but still need improvements in the Faradaic efficiency and energy efficiency of the system.

Post Graduation (M.Tech) Research Project:

Sensitivity Analysis of a 500 W Proton Exchange Membrane Fuel Cell Stack by Design of experiments"

The influences on fuel cell performance of gas pressure and flow rate parameters are studied. The fuel cell is operated at various pressure and gas flow rates are regulated by mass flow controllers placed upstream of the stack. In this study, four types of control factors considered are pressures of the fuel and oxidant and the flow rates of the fuel and oxidant to select the optimized conditions for fuel cell operation. The experimental data collected were analyzed by statistical sensitivity analysis by checking the effect of one variable parameter on the other. The mixed interaction between the factors was also considered along with main interaction to explain the model developed using the design of experiments. From the analysis, maximum fuel cell performance was found to be hydrogen flow rate, oxygen flow rate and the interaction between the hydrogen pressure and oxygen flow rate compared to all other factors and their interactions.

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(Leela Manohar Aeshala)