Amandeep Jindal

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SUMMARY

Five years of experience in research in non-metal oxygen reduction reaction catalysts for application in fuel cells, microfluidics and its application in microfluidic fuel cells.

- **Synthesis of nano-composites (Nanotechnology)**: Electrospinning
- **Material characterization**: SEM/EDS, TEM, FTIR, XRD, XPS, Raman spectroscopy
- **Electrochemical characterization**: Potenstiostat *in-situ* with FTIR, scanning electrochemical microscopy, photo electrochemical workstation, electrochemical quartz crystal microbalance
- **Fuel Cell**: PEM Fuel cell testing, microfluidic fuel cell fabrication and testing
- **Microfluidics**: Designed and developed a microfluidic fuel cell using electrospun non-noble CN_x nanofibers cathode catalyst that gives power density and stability higher than Pt cathode; **microreactors for nanoparticle synthesis**
- **Class 100 and class 1000 clean room working experience**

EDUCATIONAL QUALIFICATIONS

DEGREE	SPECIALIZATION	PERIOD	INSTITUTE	CGPA
Ph.D.	Chemical Engineering, Nanoscale Research Facility	2011 – 2017	**IIT Delhi**	8.182/10
M.S. (Research)	Chemical Engineering	2011 (converted to Ph.D in 2012)	**IIT Delhi**	Converted to Ph.D
B.Tech	Chemical Engineering	2006-10	**NIT Warangal**	7.41/10

JOURNAL PAPERS

1. **Amandeep Jindal,** Suddhasatwa Basu, Neha Chauhan, Tomofumi Ukai, Sakthi Kumar and Samudyatha Shweta, Application of electrospun CN_x nanofibers as cathode in microfluidic fuel cell***, Journal of Power Sources***, 342, 165-174, **2017**, doi: 10.1016/j.jpowsour.2016.12.047.
2. Arabinda Baruah, **Amandeep Jindal**, Chayakant Acharya, Bhanu Prakash Suddhasatwa Basu and Ashok K. Ganguli, Microfluidic reactors for the morphology controlled synthesis and photocatalytic study of ZnO nanostructures, ***Journal of Micromechanics and Microengineering***, 27, 03503 (6 pp), **2017**, doi: 10.1088/1361-6439/aa5bc4.
3. **Amandeep Jindal,** Deepak Kumar Gautam and Suddhasatwa Basu, Electrocatalytic activity of electrospun carbon nitride-polyacrylonitrile Nano fibre towards oxygen reduction reactions, ***Journal of Electroanalytical Chemistry***, 775, 198-204, **2016**, doi: 10.1016/j.jelechem.2016.05.051.
4. **Amandeep Jindal** and Suddhasatwa Basu, Improvement in Electrocatalytic Activity Of Oxygen Reduction Reaction Of Electrospun Carbon Nitride/Polyacrylonitrile Nanofibers By Addition of Carbon Black and Nafion® Fillers, ***International Journal of Hydrogen Energy***, 41, 11624-11633, **2016**, doi: 10.1016/j.ijhydene.2016.02.136.
5. **Amandeep Jindal**, Suddhasatwa Basu and Aby C. P., Electrospun carbon nitride supported on poly(vinyl) alcohol as an electrocatalyst for oxygen reduction reactions, ***RSC Advances***, 5, 69378-69387, **2015**, doi: 10.1039/c5ra10884e.
6. **Amandeep Jindal,** Harikrishnan N and Suddhasatwa Basu, Direct formic acid PEM fuel cell with electrospun carbon nitride nanofibers as cathode catalyst***, Fuel Cells (featured as back cover image)*** (Accepted on 13 February, **2017**), doi: 10.1002/fuce.201600209.

RESEARCH PROJECTS

- **Synthesis of CN_x nanofibers as non-precious ORR catalyst for direct formic acid PEM and microfluidic fuel cells**
  Ph. D Project, Department of Chemical Engineering, IIT Delhi (January, 2011–present)
  Supervisor: Prof. S. Basu

Abstract: Oxygen reduction reaction (ORR), the cathode reaction of fuel cell, is studied using carbon nitride (CN_x) as catalyst. ORR activity of CN_x is improved by dispersing it on polyacrylonitrile (PAN) nanofiber using electrospinning technique. Improved ORR activity of CN_x/PAN nanofibers as compared to native CN_x nanoparticles is observed using cyclic and linear sweep voltammetries. ORR activity of CN_x/PAN nanofibers is found to improve further due to addition of fillers: carbon black (CB) and Nafion® dispersion. Improvement in ORR activity of CN_x/PAN nanofibers, improved with filler, (referred to as CN_x nanofibers) was studied using cyclic and linear sweep voltammetries.

Collaborative projects as part of PhD: BNERC, Toyo University, Japan - NRF, IIT Delhi, India:

- **Design and fabrication of microfluidics fuel cells that utilizes CN_x nanofibers as cathode catalyst**
  Bio-Nano Electronics Research Center, **Toyo University, Kawagoe, Japan**
  9 November 2015 - 4 January 2016

Abstract: Microfluidic fuel cell (MFC) is fabricated using Y-shape polydimethylsiloxane (PDMS) microchannel, aligned and soft bonded with metallised electrodes. Polarization curves and power density curves are measured for MFC using CN_x nanofibers, Pt and Au as cathode catalysts. MFC flow architecture is optimised such that the diffusion effect, adverse to MFFC activity at low flow rates, is negligible and the maximum power densities are achieved at the flow rate of 300 µL min^{-1} as compared to flow rates of 400 µL min^{-1} and 500 µL min^{-1}. CN_x nanofibers exhibited better ability to withstand fuel crossover effect, higher power density and current density as compared to Pt and Au.

- **Synthesis of CN_x/PVA nanofibers as ORR catalyst**
  Bio-Nano Electronics Research Center, **Toyo University, Kawagoe, Japan**
  27 September, 2013 – 4 December, 2013

Abstract: Dense, multi-layered poly(vinyl) alcohol (PVA) nanofibers dispersed with catalytically active carbon nitride (CN_x) nanoparticles were synthesized using electrospinning process. Size, morphology, elemental composition, bond structure of the CN_x/PVA nanofibers were analysed using TEM, SEM, FTIR, XPS and Raman spectroscopic studies. Significant improvement in the electrocatalytic activity of CN_x nanoparticles dispersed in the nanofibers as compared to its native form was observed towards ORR by voltammetry coupled with FTIR studies. Onset potential and peak current density observed for CN_x/PVA nanofibers using cyclic voltammetry was comparable to conventional Pt/C (40:60 % by weight) catalyst. ORR mechanism was further analysed using RRDE and *in-situ* FTIR with linear sweep voltammetry studies. RRDE analysis confirmed that ORR takes place primarily via 4-electron pathway. The catalytic activity of CN_x/PVA nanofibers for ORR was stable over 5000 repetitions of voltammetric studies coupled with FTIR.

Research project under CENIDE nanosummer program 2013

- **Nanoparticle composite synthesis**
  University of Duisburg-Essen, Germany
  2 June, 2013 to 20 July, 2013
  Professor/Group Leader: Prof. Dr.-Ing. Stephan Barcikowski

Abstract: Laser ablation in liquid offers a unique route to fabricate nanoparticles without any impurities. If the liquid is a monomer or polymer solution, nanopatricle polymer composites are fabricated in one set in one batch without using any chemical precursors and without the need of using matrix binders. Within the NanoSummer, the synthesis parameters parameters were optimized for Ag-PEG nanocomposites, and sub-stoichiometric nanoparticles were fabricated.

Summer project during B. Tech.

- Development and characterization of egg albumin/poly(vinyl) alcohol blends and nanofibers for food packaging applications
  National Chemical Laboratory (NCL) Pune
  April 21, 2008 to July 11, 2008

Abstract: Films of blends of various compositions of egg albumen and poly(vinyl alcohol) were cast, characterized and evaluated thermal and swelling properties of the films. Egg albumen/poly(vinyl alcohol) nanofibers were also prepared using electrospinning and characterized.

SUMMER SCHOOLS

- "Center for Nanointegration Duisburg-Essen (CENIDE) Nanosummer program" on nanotechnology, **University of Duisburg-Essen, Germany**, June 2 to July 20, 2013
- "SERC School on Electrochemical Systems", Department of Chemistry and Chemical Engineering, IIT Bombay, Mumbai, India, May 16th to 28th, 2011.
  Received a certificate for excellent performance in the quiz conducted at the end of the school

CONFERENCES

- Design and fabrication of microfluidic fuel cell, National Symposium on Nano Science and Technology 2016, Center for Nano Science and Engineering (CeNSE), Indian Institute of Science (IISc) Bangalore, 29th – 30th June 2016
- Electrospun Carbon Nitride Supported on Polyacrylonitrile as an Electrocatalyst For Oxygen Reduction Reaction, **Amandeep Jindal,** Suddhasatwa Basu, Neha Chauhan, Tomofumi Ukai, Yoshikata Nakajima and Sakthi Kumar (Poster), 13th International Symposium on Bioscience and Nanotechnology, Bio-Nano Electronics Research Centre, Toyo University, Japan, 26th – 28th November, 2015
- Synthesis of carbon nitride/polyacrylonitrile nanofibers using electrospinning as effective non-platinum catalyst for oxygen reduction reaction in fuel cells, **Amandeep Jindal**, Deepak Kumar Gautam and Suddhasatwa Basu (Oral), 6th International conference on advanced nanomaterials, ANM 2015 Conference, University of Aveiro, Portugal, 20-22 July, 2015
- Electrocatalytic activity of electrospun carbon nitride nanofibers on different supporting polymers for oxygen reduction reaction in fuel cells, **Amandeep Jindal**, Deepak Kumar Gautam and Suddhasatwa Basu (Oral), International Conference on Nanotechnology, Nanomaterials & Thin Films for Energy Applications, Manchester Conference Centre, Manchester, UK, 1-3 June 2015
- Design and fabrication of 3-dimensional membraneless micro fuel cells**, Amandeep Jindal**, Suddhasatwa Basu, Tomofumi Ukai, Sakthi Kumar and Toru Maekawa, International Conference on Electrochemical Science and Technology, ICONEST – 2014, Electrochemical Society of India (ECSI), Indian Institute of Science, Bengaluru, India, 7-9th August 2014 (**Best poster award**)
- Development of carbon nitride/PVA nanofibers using electrospinning for oxygen reduction reaction in fuel cells, **Amandeep Jindal** and Suddhasatwa Basu (Oral), International Conference on Electrochemical Science and Technology, ICONEST – 2014, Electrochemical Society of India (ECSI), Indian Institute of Science, Bengaluru, India, 7-9th August 2014
- Development of Carbon Nitride Nanofibers and its Application for Oxygen Reduction Reaction in Fuel Cells, **Amandeep Jindal** and Suddhasatwa Basu (Poster), **Open house 2013**, IIT Delhi (**Third prize**)

WORKSHOPS

- Indian Nanoelectronics User Program (INUP) Training Workshop in "Nanofabrication Technologies", Center for Nanoscience and Engineering (CeNSE), Indian Institute of Science (IISc), Bangalore from 21 – 23 May 2014
- Indian Nanoelectronics User Program (INUP) Training Hands on Training in "Nanofabrication Technologies", Center for Nanoscience and Engineering (CeNSE), Indian Institute of Science (IISc), Bangalore from 27 June - 3 July 2014
- Workshop on Nanoscale Devices and Fabrication, IIT Delhi, 10th November, 2012
- 3rd EICOON (Euro-Indo Forum on Energy) Workshop on Nano Materials in Solar Energy Applications, CSIR-CGCRI and SNBNCBS, Kolkata, May 3-4, 2012
- 2nd Indo-Italian Workshop on Electrochemistry for Future Energy Solutions, November 30, 2011 to December 1, 2011, Department of Chemistry, University of Delhi, New Delhi

AWARDS AND ACHIEVEMENTS

- **Best poster award:** Design and fabrication of 3-dimensional membraneless micro fuel cells**, Amandeep Jindal**, Suddhasatwa Basu, Tomofumi Ukai, Sakthi Kumar and Toru Maekawa, International Conference on Electrochemical Science and Technology, ICONEST – 2014, Electrochemical Society of India (ECSI), Indian Institute of Science, Bengaluru, India, 7-9th August 2014
- **Third prize (poster):** Development of Carbon Nitride Nanofibers and its Application for Oxygen Reduction Reaction in Fuel Cells, **Amandeep Jindal** and Suddhasatwa Basu (Poster), **Open house 2013**, IIT Delhi
- GATE 2011 qualified (Score: 375)
- Secured 2nd position in Technical Quiz conducted by **IOCL** (Indian Oil Corporation Limited) during Technozion 08 (a national level technical festival of NIT Warangal).
- Received the **bronze medal** (3rd prize) and scholarship, in MathQ2003-the annual Punjab State Level Mathematics Test. Secured 9th position in MathQ2002.
- Received Merit Certificate in **Jagritie Independent Scholarship Scheme** 2001 conducted by National Centre for Talent Promotion, Rashtriya Jagritie Sansthan, New Delhi.

POSITIONS OF RESPONSIBILITY

- Actively participated in setting up of a laboratory that is responsible for electrochemical studies as a part of the **Nanoscale Research Facility (NRF), IIT Delhi, India**
- Actively participated in setting up of **microfluidics laboratory** at Department of Chemical Engineering, IIT Delhi, India
- Event Manager, Dues Ex Machina (a Chemical Engineering car racing event) at Technozion '09 (a technical festival of NIT Warangal)
- Organiser, Confluence 08 (technical event of IIChE, Students Chapter, NITW)
- Organiser, Turbulance (technical quiz), Technozion '07

PERSONAL INTERSTS AND HOBBIES

- Active paricipant of dramatics club of NIT Warangal during B. Tech.
- Regular player of tabla (Indian classical musical instrument) during school days
- Caption writing. Some of my captions are published as best entries in caption contest in the internet edition of the newspaper "The Tribune"
- Teaching school students.
- Playing sports like Cricket and Badminton