

CURRICULUM VITAE

1. Name: SUSANTA BANERJEE
2. Date of Birth: 01 April 1964
3. Designation & Official Address: Professor (HAG) & Former Head
Materials Science Centre
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4. Academic Credentials:

- **Postdoctoral Fellow:** TU Munich, Alexander von Humboldt Fellow (Germany), July 1997 to February 1999
- **Doctor of Philosophy:** Indian Institute of Technology Kharagpur, Kharagpur, India, 1993 (*Thesis Title: Phosphorus Containing Polymers*)
- **Master of Technology:** Materials science and engineering, Indian Institute of Technology Kharagpur, Kharagpur, India, 1990
- **Master of Science:** Chemistry, Indian Institute of Technology Kharagpur, Kharagpur, India, 1988

5. Scholastic accomplishment:

- ***h-index* / total citation:** 35 / 4418+, ***i10-index*:** 126
- **Google Scholar:** <https://scholar.google.co.in/citations?user=27V8W6sAAAAJ&hl=en>
- **ORCIDid:** <https://orcid.org/0000-0002-0358-3198>
- **Scopus author ID:** 7404544930

5. Specialization: Materials Science and Engineering

- **Research Interests:** High performance polymers, Membrane based separation, Proton exchange membrane, Hyperbranched polymers, Light emitting polymers, Polymer nanocomposites.

6. Teaching Experience:

- A. Taught various courses in polymer in the Department of Chemicals Sales and Marketing, Jiwaji University, Gwalior, India as a visiting faculty (From 1995 to February 2004))
- B. Teaching B.Tech., M. Tech. and Ph. D. Students at IIT Kharagpur since 2006; 1. Techniques for Materials Characterization (MS60002); 2. Manufacture of Industrial Polymers (MS60015); 3. Technology of Natural and Synthetic Elastomers (MS60018); 4. Materials Lab (MS69003); 5. Polymer Technology (MS41004); 6. Science and Technology of Polymers (MS60011); 7. Polymers for electronic and photonic applications (MS60066).

7. Research, Teaching and Industrial Experience (29 years)

University / Organization	Designation	From	To	Total Period	Nature of Experience
IIT Kharagpur	Professor	Dec., 2011	Till date		Teaching, M. Tech. & Ph. D thesis supervision, Fund generation through Govt. Projects, Laboratory setup, Cost analysis and Project Management. Leading a group of 10 Ph. D and 6 M. Tech. Students.
IPF Dresden	AvH Fellow	June, 2019	Nov., 2019	6 Months	With sabbatical leave, Research and lecturing.
IIT Kharagpur	Professor & Head	May, 2014	May, 2017	3 years	Teaching, M. Tech. & Ph. D thesis supervision, Fund generation through Govt. Projects, Laboratory setup, Cost analysis and Project Management. Managing a group of 11 faculty and 12 supporting staff, 60 Ph. D. and 40 M. Tech. Students.
IIT Kharagpur	Associate Professor	April, 2007	Dec., 2011	4 years 8 months	-DO-
IIT Kharagpur	Assistant Professor	Jan., 2006	March, 2007	1 year 3 months	-DO-
GE India Technology Centre, Bangalore	Lead Polymer Scientist	May, 2004	Dec., 2005	1 year 8 months	Customer focused research and product development. Regular basis presentation to the customers and understand their needs (CTQ's). Platform research on new products and new product introduction (NPI). Leading and owning different projects.
DRDE, Gwalior	Scientist 'D'	July, 2000	April, 2004	3 years 9 months	Research & Development of products of defence interest. Project Management Guidance of Ph. D. and masters students. Mentoring and developing of junior Scientists. Officer in charge of the DRDE audit cell. Member scientist of the DRDE technical evaluation committee.
DRDE, Gwalior	Scientist 'C'	Feb., 1999	June, 2000	1 year 4 months	Research & Development. Guidance of Ph. D. and Masters students. Project management. Organiser weekly (1999-2003) chemical science seminar.
TU Munich, Germany	AvH Fellow	July, 1997	Feb., 1999	1 year 8 months	Research
DRDE, Gwalior	Scientist 'C'	July, 1995	June, 1997	2 years	Research & Product Development (Part time teaching at Jiwaji University, Gwalior)
Defence R & D Organisation (DRDE, Gwalior)	Scientist 'B'	Dec., 1991	June, 1995	3 years 6 months	Research & Product Development

8. Academic / Professional Awards (honours):

- Merit Cum Means (MCM) fellowship from IIT Kharagpur (1986 to 1988).
- NET (CSIR, JRF) and GATE fellowship (1988).
- Alexander von Humboldt (AvH) Fellowship (TU Munich, Germany), July 1997 to Feb. 1999.
- Defence Technology Spin-off Award for the development of Slow Release Insecticidal Paint, 2001
- Commendation Certificate and Medal by the SA to Defence Minister on National Science Day, 28 Feb. 2001.
- GE Company Certification as a **GE Green Belt – DFSS in Six Sigma, 2005**
- **GE Management Award** for the development of new grade SILTEM Copolymer, 2005
- **Reviewer:** J. Polym. Mater., J. Appl. Polym. Sic., Polymer, Macromolecules, ACS Appl. Mater. Interfaces, Macromol. Chem. Phys., J. Polym. Sci. Part A : Polym. Chem., Eur. Polym. J., Polym. Intern., Polym. J., J. Membr. Sci., Chem. Com., JACS, Polym. Adv. Technol., Langmuir, Angew. Chem. RSC-Adv., Sep. & Pur. Tech., Syn. Mat.
- **Ph.D. Thesis Examiner:** Anna University, Madras University, Cultivation of Science, Jadavpur University, Calcutta University, Visva-Bharti University, Tezpur University, Utkal University, Sambalpur Univesity, Veer Surendra Sai University Of Technology, Central University Hyderabad, Nagpur University, Benaras Hindu University, IIT-BHU, IIT Bombay, IIT Delhi, NITK Surathkal, NIT Nagpur, NCL Pune, CLRI Chennai, University of Johannesburg, University of Stellenbosh.
- **Editorial Board Member:** Journal of Polymer Materials: An International Journal (Prints Publications Pvt. Ltd., New Delhi), e-Polymers (Walter de Gruyter GmbH & Co. KG (Berlin/Germany), Chemistry Africa-Springer, International Journal of Plastics Technology (IJPT) (Springer), Polymer Engineering and Science (PES) (Wiley).

9. Affiliation to Scientific/Technical Committees at State/National/International level:

- Panel member of “High Energy Materials” of Armament Research Board (ARMREB) of DRDO
- Member of the International Selection Board of the Henri Moissan International Prize of France

10. Membership of professional bodies:

- Society of Polymer Science of India (Life member, since 1993, **KH-3**)
- Materials Research Society of India (Life member, since 2006, **LM B869**)
- American Chemical Society (Membership No. **30116196**)

11. Fellowship/Medal:

- Fellow of West Bengal Academy of Science and Technology (**FWAST**), 2014
- MRSI Medal, 2016

12. Invited Lectures:

- Fluoropolymer 2002, Savannah, USA
- MACRO 2002 (IIT- Kharagpur)
- Polymer 2006, IACS Jadavpur, Kolkata
- SAMPADA-2008, Pune, India
- Philipps-Universität Marburg, Germany (2008, 2009, 2010, 2012)
- Fluoropolymer 2008, Charleston, USA

- Leibniz-Institut für Polymerforschung Dresden, Germany (2008, 2010)
- University of Dusseldorf, Germany(2010)
- Fluoropolymer 2010, Meze, France
- APM2010, CIPET, Bhubaneswar
- Colloquium on perspectives in polymer science & technology, at IACS, Jadavpur (2010)
- MACRO 2010 (IIT- Delhi)
- ICME 2011, Pune
- PRC 2012, SPSI-Calcutta Chapter
- Bayreuth Polymer Symposium (BPS-13), Bayreuth, Germany (2013)
- FAPS-MACRO 2013, Bangalore
- RAPT 2014, Kolkata
- UGC-NCRM workshop on Polymers at IISC Bangalore (2014)
- MACRO 2015, Kolkata
- APM 2016 (CIPET Ahmedabad)
- International Conference on Science and Engineering of Polymeric Materials (SEPM 2016), Monastir, Tunisia
- European Polymer Federation Congress (EPF 2015), Dresden, Germany
- Bayreuth University, Germany (2016)
- Ghent University, Belgium (2016)
- STEPI 10, Polyimides and High Performance Polymers, 6 to 8 June 2016, Montpellier, France
- Fluoropolymer 2016, New Orleans, USA
- KaSAM 2016 (Pokhara, Nepal)
- Department of Polymer Engineering, University of Akron, 2016
- MACRO 2018 (IISER – Pune)
- ICSM 2018 (MNNIT-Jaipur)
- Tennessee Tech University, Tennessee, USA, October 22 to 26, 2018
- IGSTC 2019 (CSMCRI-Bhavnagar)
- Institute of Molecular Compounds, RAS, Saint-Petersburg, April 17, 2019
- Technische Universität Chemnitz, Germany, July 8, 2019
- Technische Universität Wien, Austria, August 5, 2019
- University of Bayreuth, Germany, September 2, 2019
- International Conference on Polymer and Rubber Technology, IIT Kharagpur, 24 to 27 September, 2019
- International Conference on Advances in Polymeric Materials (APM 2020), 13-15 February, Bangalore

13. Visiting Scientist:

- Technical University Munich, Germany, Alexander von Humboldt Fellow: **Twenty months** (July 1997 to February 1999)
- Leibniz-Institut für Polymerforschung Dresden, Germany, Alexander von Humboldt Fellow: **Two months** (May 2007 to July 2007)
- Leibniz-Institut für Polymerforschung Dresden, Germany, Alexander von Humboldt Fellow: **Two months** (May 2008 to July 2008)

- Leibniz-Institut für Polymerforschung Dresden, Germany, INSA-DFG Fellow: **Two months**, (May 2009 to July 2009)
- Marburg University, Germany, Alexander Von Humboldt Fellow: **Two months** (May 2010 to July 2010)
- Leibniz-Institut für Polymerforschung Dresden, Germany, Alexander von Humboldt Fellow: **Two months** (May 2012 to July 2012)
- Leibniz-Institut für Polymerforschung Dresden, Germany, Alexander von Humboldt Fellow Two months (May 2016 to July 2016).
- Leibniz-Institut für Polymerforschung Dresden, Germany, IPF Fellow: **Two months** (May 2017 to July 2017).
- Leibniz-Institut für Polymerforschung Dresden, Germany, Alexander von Humboldt Fellow: **Six months** (June 2019 to November 2019).

14. Publication/Research Guidance:

PUBLICATIONS (Annexure I)	Number published / accepted / granted	Number under review
a. Publications in refereed Journals	209	04
b. Proceedings of seminars / conferences	150	0
c. Books and Monographs	10 (Chapters in Book) 01 (Book)	-
d. Patent / copyright obtained / filed	07 Granted	12 Applied
e. Course materials prepared under CEP/technical report	08	-
RESEARCH GUIDANCE (Annexure II)	Number completed	Number in progress
a. Guidance at doctoral level	21	07
b. Guidance at masters level	35	02

15. Product Development/Traslatinal research:

Annexure III

16. Sponsored projects:

- Synthesis and characterization of processable novel co(polyetherimide)s as low dielectric constant material for microelectronic packaging (Funding agency: IIT Kharagpur; Project cost: Rs. 3,00,000 /=-, IIT-Kharagpur-SRIC Reference: SCP), PI: Susanta Banerjee (Completed: 31-05-2009).
- Preparation of Novel Polymeric Materials for Chemical Sensor Application: Synthesis and Tailoring of Properties in Molecular Level (Funding agency: Defence Research & Development Establishment (DRDE), Ministry of Defence, Gwalior; Project cost: Rs. 7, 54,400 / =, IIT-Kharagpur-SRIC Reference: NPM), PI: Susanta Banerjee (Completed: 31-08-2008).
- Molecularly engineered novel membrane precursors and preparation of novel polymer nano-composite membranes for selective separation of gas mixtures (Funding agency: DST; Amount: Rs. 50, 95,668/=-, IIT-Kharagpur-SRIC Reference: SGM), PI: Susanta Banerjee (Completed: 30-04-2010).
- Synthesis and characterization of novel light emitting poly(arylene)s and poly(arylene ether)s and derivative thereof (Funding agency: CSIR; Amount: Rs. 9,06, 000/=-, IIT-Kharagpur-SRIC Reference: NLE), PI: Susanta Banerjee (Completed: 31-08-2010).

- Grant for equipment purchase (Funding agency: Alexander von Humboldt Foundation, Germany. Amount received: Rs. 9, 02,836/= (Grant received in 2008).
- Preparation and supply of poly(ether imide siloxane)s as membrane materials in bulk quantity for analytical sample inlet' (Funding agency: DRDE Gwalior; Project cost: Rs. 8,52,400 / =, IIT-Kharagpur, SRIC Reference, MMB), PI: Susanta Banerjee (Completed: 31-01-2011)
- Novel hyperbranched polyethers and polyetherimides based on elastomeric building blocks: Investigation into structure-property relationship (Funding agency, DST; Amount: Rs. 13, 68,000/=, IIT-Kharagpur-SRIC Reference: NHP), PI: Susanta Banerjee, Co-PI: Mahua Dhara (Completed: 14-05-2012).
- High strength polyimide-siloxane films with low heat shrinkage (Funding agency: DRDE, Gwalior; Project cost: Rs. 9, 98,400 / =, IIT-Kharagpur-SRIC Reference: SFH), PI: Susanta Banerjee (Completed: 06-03-2013).
- Novel polymeric composite membranes for selective separation of gas mixtures (Funding agency: DST; Amount: Rs. 55, 00,000/= , IIT-Kharagpur-SRIC Reference: PMS), PI: Susanta Banerjee (Ongoing)
- Centre of excellence for training and research in microfluidics (Funding agency: IIT Kharagpur; Amount: Rs. 250, 90,000/=, IIT-Kharagpur-SRIC Reference: CEM) PI: Suman Chakraborty & Sunanda Dasgupta, Co-Investigator: Susanta Banerjee and others (Ongoing).
- Development of the fourth circuit element “Fractance” (Funding agency: IIT Kharagpur; Amount: Rs. 94, 50,000/=, IIT-Kharagpur-SRIC Reference: CEI), PI: Karabi Biswas, Co-Investigator: Siddhartha Sen and Susanta Banerjee (Ongoing).
- Development of electrically conducting and EMI shielding effectiveness in polymer/MWCNT/grapheme composites at very low filler loading (Funding agency: DST; Amount: Rs. 59, 19,600/=, IIT-Kharagpur-SRIC Reference: FML), PI: B.B. Khatua, Co-PI: Susanta Banerjee (Ongoing).
- Creation of novel high performance membrane materials and membranes based on them (Funding agency: DST; Amount: Rs. 26, 24,320/-, IIT-Kharagpur-SRIC Reference: HAB) PI: Susanta Banerjee (Ongoing).
- FIST grant (Funding agency: DST; Ref. SR/FST/ETII-068/2016, Amount: Rs. 350, 00,000/=, IIT-Kharagpur-SRIC Ref: FPK), PI: Head, Matsc. Centre, Co-PI: Susanta Banerjee (Ongoing).
- Bio-inspired large area conformal and flexible sensors for biomedical and robotic applications (Funding agency: DST; Amount: Rs. 24, 35,000/-, IIT-Kharagpur-SRIC Reference: AFR), PI: Soumen Das, Co-PI: Susanta Banerjee (Ongoing).
- Development and demonstration of integrated instrumentation system for quantitative detection of water contaminants with information database for surveillance of waterborne diseases (Funding agency: DST; Amount: Rs. 24, 35,000/-, IIT-Kharagpur-SRIC Reference: IQC), PI: Karabi Biswas, Co-PI: Susanta Banerjee (Ongoing).
- Bio-inspired large area conformal and flexible sensors for biomedical and robotic applications (Funding agency: MEITY; Amount: Rs. 39, 00,000/-, IIT-Kharagpur-SRIC Reference: BLB_NNK), PI: Soumen Das, Co-PI: Susanta Banerjee (Ongoing).
- Development and demonstration of integrated instrumentation system for quantitative detection of water contaminants with information database for surveillance of waterborne diseases (Funding agency: MEITY; Amount: Rs. 39, 00,000/-, IIT-Kharagpur-SRIC Reference: NQS_NNK), PI: Karabi Biswas, Co-PI: Susanta Banerjee (Ongoing).
- Fabrication and Demonstration of All-Solid-State High Performance Flexible Supercapacitor Device (Funding agency: DST; Amount: Rs. 40, 88,560/-, IIT-Kharagpur-SRIC Reference: FPD), PI: Debabrata Pradhan, Co-PI: Susanta Banerjee (Ongoing).
- Piezoelectric / Triboelectric Nanogenerator Driven Flexible Self Charging Symmetric / Asymmetric Supercapacitor Devices for Sustainable Power Generation (Funding agency: DST;

Amount: Rs. 42, 77,120/-, IIT-Kharagpur-SRIC Reference: NDP), PI: Bhanu Bhusan Khatua, Co-PI: Susanta Banerjee (Ongoing).

17. Consultancy Project:

- Thermoset polymer based meter boxes & distribution boxes: An ecological disaster (Client: Ester Industries Limited, Gurgaon; Amount: Rs. 4, 96,350/=, SRIC Reference, TPBM) Consultant: Susanta Banerjee (Project duration: 12 October 2010 to 13 October 2011).
- Synthesis of the soluble para-aramid polymers, [Client: KERMEL-France, Amount: EUR: 10,000/= (Rs. 6, 79,000/=), SRIC Reference, SPAP] Consultant: Susanta Banerjee (Project duration: 15 November 2011 to 14 November 2012).
- Synthesis of the soluble para-aramid polymers, Phase II. [Client: KERMEL-France, Amount: EUR: 5,000/= (Rs. 3,52,640/=), SRIC Reference, SPAP] Consultant: Susanta Banerjee (Project duration: 25 January 2013 to 24 January 2014).
- Synthesis of PI-PDMS materials and preparation of membranes, [Client: L&T Heavy Engineering, Strategic Electronics Centre, Bangalore, Amount: Rs. 9, 98,880/=, SRIC Reference, PPMA] Consultant: Susanta Banerjee (Project duration: 01 April 2014 to 31 March 2015).
- To provide advice on reproducible synthesis and characterization of polymers, [Client: Sun Pharmaceuticals Industries Ltd, Amount: Rs. 4, 72,000/=, SRIC Reference, ARSP] Consultant: Susanta Banerjee (Project duration: 23 September 2019 to 22 September 2020).

18. Major administrative responsibilities:

Position	From and to	Major role
Head, Mat. Sci. Centre	08-05-2014 to 07-05-2017 (3 years)	Managed more than 70 Ph.D. and 60 Master students and 12 faculty members
Chairman of the Commercial Establishments and Commercial Committee (CELC).	01-01-2015 to 31-12-2017 (3 Years)	Managed more than 200 commercial establishments at IIT Kharagpur
Warden, MMM Hall, IIT Kharagpur	17-11-2010 to 31-10-2014 (~4 Years)	Managed 1600 students with help of 4 Assistant wardens 150 workers.

18. Other Academic Activities:

- **Proceeding coordinator:** Emerging Trends in Polymer Science and Technology “ETPST – 2006” organized jointly by SPSI and IIT-KGP at IIT KGP, 8-9 Sept 2006.
- **Treasurer:** International conference on Hi-tech materials organized jointly by IIT KGP and DMSRDE Kanpur at IIT KGP, 11-13 December 2009.
- **Convener (Joint):** International Year of Chemistry (IYC) 2011 & Symposium on Frontiers in Polymer Chemistry (FPC), IIT Kharagpur, November 29-30, 2011.
- **Convener (Joint):** International Conference on Functional Materials (ICFM-2014), Organized by the Materials Science Centre, IIT Kharagpur, February 5-7, 2014.
- **President,** Society for the Polymer Science, Kharagpur Chapter (2010- May, 2015).
- **Coordinator (Joint):** AICTE sponsored short term course on “Renewable Energy Materials and their Industrial applications”, Materials Science Centre, IIT Kharagpur November 05-16, 2012.
- **Principal coordinator:** Organizer AICTE sponsored short term course on “Materials for Advanced Applications”, Materials Science Centre, IIT Kharagpur, September 02-13, 2013.

- **Co-convener:** Macro 2015, held at Indian Association for the Cultivation of Science (IACS), Kolkata, January 23-26, 2015.
- **Convener:** International Conference on Functional Materials (ICFM 2016), Organized by the Materials Science Centre, IIT Kharagpur, January 12-14, 2016.
- **Convener:** International Conference on Functional Materials (ICFM 2020), Organized by the Materials Science Centre, IIT Kharagpur, January 06-08, 2020.
- Completed the flagship Leadership Development training program “*Leadership for Academicians Programme (LEAP)*” sponsored by the Ministry of Human Resource Development, Govt. of India during February 25 to March 07, 2020 organized by IIT Bombay.

19. Research collaborators:

<p>Prof. Makarand M. Ghangrekar Department of Civil Engineering IIT Kharagpur Kharagpur, India Email: ghangrekar@civil.iitkgp.ac.in</p>	<p>Prof. Rabibrata Mukherjee Department of Chemical Engineering IIT Kharagpur Kharagpur, India Email: rabibrata@che.iitkgp.ac.in</p>
<p>Prof. Dr. Brigitte Voit Leibniz-Institut für Polymerforschung Dresden e.V. Hohe Str. 6, 01069 Dresden Germany Email: voit@ipfdd.de</p>	<p>Prof. Dr. Yuri Yampolskii A.V. Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, 29 Leninsky Prospect, 119991, Moscow, Russia Email: yampol@ips.ac.ru</p>
<p>Prof. Venkata Padmanabhan Department of Chemical Engineering Tennessee Tech University 1020 Stadium Dr. Prescott Hall 307 Cookeville, TN 38505, USA Email: vpadmanabhan@tntech.edu</p>	<p>Prof. Amitava Patra Indian Association for the Cultivation of Science Jadavpur, 2A & 2B Raja S C Mullick Road Kolkata 700032 India Email: msap@iacs.res.in</p>
<p>Prof. Seema Agarwal Makromolekulare Chemie II Gebäude NWII, Universität Bayreuth Universitätsstrasse 30, 95440 Bayreuth, Germany Email: agarwal@uni-bayreuth.de</p>	<p>Prof. Andreas Grainer Makromolekulare Chemie II Gebäude NWII, Universität Bayreuth Universitätsstrasse 30, 95440 Bayreuth, Germany Email: andreas@uni-bayreuth.de</p>
<p>Dr. Hartmut Komber Leibniz-Institut für Polymerforschung Dresden e.V. Hohe Str. 6, 01069 Dresden Germany Email: komber@ipfdd.de</p>	<p>Dr. Nikolay Belov A.V. Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, 29 Leninsky Prospect, 119991, Moscow, Russia Email: belov@ips.ac.ru</p>

LIST OF PUBLICATION**A. Papers in Refereed Journals****Year 2020**

213. A. Mohanty, U. P. Singh, A. Ghorai, **S. Banerjee**, R. J. Butcher, Metal-Organic Frameworks Derived From Semi-rigid Anthracene Based Ligand and Sulfonates: Proton Conductivity and Dye Degradation Studies, *Chem. Asian J.* (Communicated).
212. D. Chakraborty, A. Ghorai, A. Chowdhury, **S. Banerjee**, A. Bhaumik, A novel tetradentate phosphonate ligand based Ni-MOF as high performance proton conducting material for fuel cell application, *J. Mater. Chem. A* (Under revision).
211. S. K. Bhattacharyya, M. Dule, R. Paul, J. Dash, Md. Anas, T. K. Mandal, N. C. Das, **S. Banerjee**, Carbon dots-gelatin nanocomposite hydrogel for pH-responsive drug delivery and pH sensing application, *ACS Biomaterials Sci.Eng.* (Communicated).
210. S. Saha, **S. Banerjee**, Effect of Sulfonic Acid Functionalized Polysilsesquioxane on New Semifluorinated Sulfonated Polytriazole Composites and Investigation of Proton Exchange Membrane Properties, *Polym. Eng. Sci.* (Communicated)
209. R Mukherjee, A. K. Mandal, **S. Banerjee**, Sulfonated Poly(arylene ether sulfone) Functionalized Polysilsesquioxane Hybrid Membranes With Enhanced Proton Conductivity, *e-Polymers* (2020, Accepted)
208. S. Roy, A. Ghorai, H. Komber, B. Voit, **S. Banerjee**, Synthesis of 2,2'-Hindered Pyridine Containing Semifluorinated Polytriazoles and Investigation for Low Temperature Proton Exchange Membrane Application with Enhanced Oxidative Stability, *Eur. Polym. J.* (2020, Accepted).
207. R. Chatterjee, A. G. Kumar, R. Nikiforov, V. Ryzhikh, N. Belov, V. Padmanabhan, Y. Yampolskii, **S. Banerjee**, Gas transport properties of new semi-fluorinated, high-strength poly(ether imide) membranes with benzyl ether side group, *Eur. Polym. J.* (doi.org/10.1016/j.eurpolymj.2020.109879).
206. R. Moi, A. Ghorai, **S. Banerjee**, K. Biradha, Amino and Sulfonate Functionalized Metal-Organic Framework for Fabrication of Proton Exchange Membranes with Improved Proton Conductivity, *Cryst. Growth Des.* (doi.org/10.1021/acs.cgd.0c00732).
205. A. Ghorai, S. Roy, S. Das, H. Komber, M. M. Ghangrekar, B. Voit, **S. Banerjee**, Chemically Stable Sulfonated Polytriazoles Containing Trifluoromethyl and Phosphine Oxide Moieties for Proton Exchange Membranes, *ACS Appl. Polym. Mater.* Vol. 2, 2020, pp. 2967-2979.
204. S. C. Pal, S. Chand, A. G. Kumar, P. G. M. Mileo, I. Silverwood, G. Maurin, **S. Banerjee**, S. M. Elahi, M. C., A Co (II)-Coordination Polymer for Ultrahigh Superprotonic Conduction: An atomistic Insight through Molecular Simulations and QENS Experiments, *J. Mater. Chem. A* Vol. 8, 2020, pp. 7847-7853.
203. A. Mandal, A. Ghorai, **S. Banerjee**, Sulfonated Polysilsesquioxane-Polyimide Composite Membranes: Proton Exchange Membrane Properties, *Bull. Mater. Sci.* (2020, Accepted)
202. A. G. kumar, S. Saha, B. K. Tiwari, M.M. Ghangrekar, A. Das, R. Mukherjee, **S. Banerjee**, Sulfonated co-poly(ether imide)s with alkyne Groups: Thermally Crosslinking Through Alkyne-Azide Click Reaction and Studies on Proton Exchange Membrane Properties and Microbial Fuel Cell Performance), *Polym. Eng. Sci.* (doi.org/10.1002/pen.25454).
201. S. P. Moreno, P. Sharan, J. Engelke, H. Gumz, U.Oertel, P. Wang, **S. Banerjee**, R. Klajn, B. Voit, A. Lederer, D. Appelhans, Light-driven proton transfer triggering adaptive, cyclic and temporal switching of enzymatic nanoreactors, *Small* (Accepted).
200. D. A. John, **S. Banerjee**, K. Biswas, Nanocomposite material characterization of solid state fractional capacitor, *IEEE Trans. Electron Devices* Vol. 67, 2020, pp. 1136-1142.
199. S. Roy, S. Saha, A. G. Kumar, A. Ghorai, **S. Banerjee**, Synthesis and characterization of new sulfonated co-polytriazoles and their proton exchange membrane properties, *J. Appl. Polym Sci.* Vol. 137 2020 pp. 48514.

198. A. Ghorai, A. K. Mandal, **S. Banerjee**, Synthesis and characterization of new phosphorus containing sulfonated polytriazoles for proton exchange membrane application, *J. Polym. Sci.* Vol. 58, **2020**, pp. 263-279.
197. R. Chatterjee, A. Singh, A. G. Kumar, B. Voit, **S. Banerjee**, Star-shaped sulfonated poly(ether triazole)s: Proton exchange membrane properties, *Eur. Polym. J.* Vol. 123, 2020, pp. 109443

Year 2019

196. A. Ghorai, A. G. Kumar, **S. Banerjee**, K. Biradha Proton conducting hydrogen-bonded 3D-frameworks of imidazo-pyridine-based coordination complexes containing naphthalene disulfonates in rhomboid channels, *Chem. Asian J.* Vol. 14, **2019**, pp. 4389-4394.
195. N. Mitra, D. Prasad, **S. Banerjee** Identification of molecular vibrations associated with tactic-ity in polypropylene: Density functional theory-based simulations, *J. Polym. Sci. Part B: Polym. Phys.* Vol. 57, **2019**, pp. 1378-1385.
194. A. Singh, A. G. Kumar, S. Saha, R. Mukherjee, S. Bisoi, **S. Banerjee**, Synthesis and characterization of chemically stable sulfonated copoly(triazole imide)s with high proton conductivity, *Polym. Eng. Sci.* Vol. 59, **2019**, pp. 2279-2289.
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38. S. Maji, S. Sen, B. Dasgupta, **S. Banerjee 2008** Pervaporation Studies of Fluorine Containing AromaticPoly(ether amide) Membranes, *SAMPADA-2008*, 8-12 December 2008, Pune, India.
37. S. Maji, S. Sen, M. Dhara, **S. Banerjee**, New Aromatic Poly(ether amide)s Containing Phenolphthalein Anilide in the Main Chain, *10th Intern. Conf. on Adv. Mater. (IUMRS-ICAM)*, 8-13 October 2008, Bangalore, India.
36. **S. Banerjee**, S. Sen, B. Dasgupta **2008** Novel Semi-Fluorinated Poly (ether imide) s with Cardo Unit in the Main Chain, *Fluoropolymer 2008: Current frontiers and future trends*, 19-22 October 2008, Charleston, USA.

Year 2007

35. A. Ghosh, **S. Banerjee**, Fluorinated poly (imide siloxane) copolymers: synthesis characterization and properties, *Young Scientists' Colloquium -07*, 27 July 2007, University of Calcutta, India.

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34. S. Gupta, D. D. Agarwal, **S. Banerjee**, Synthesis, characterization and thermal study of Ca-Al-X series of hydrotalcites, *Intern. Symp. on Mater. Chem., ISMC-2006*, 4-8 December 2006.
33. S. Gupta, D. D. Agarwal, **S. Banerjee**, Novel heat resistant PVC formulations using Li-Al-X and Zn-Al-X series of hydrotalcites as stabilizers, *National Symp. on Modern Trends in Chem. Sci.*, 8-9 October 2006, Kurukh University, India.
32. S. Gupta, D. D. Agarwal, **S. Banerjee**, Novel heat resistant PVC formulations using hydrotalcites as stabilizer, *Emerging Trends in Polym. Sci. and Technol. "ETPST-2006"*, 8-9 September 2006, IIT Kharagpur, India.
31. A. K. Digal, A. Ghosh, **S. Banerjee**, Synthesis of Novel Hyperbranched polyimide "*EPTS-2006*", 8-9 September 2006, IIT Kharagpur, India.
30. A. Ghosh, **S. Banerjee**, Preparation and Characterization of novel aromatic polyimide-polydimethylsiloxane random copolymer "*EPTS-2006*", 8-9 September 2006, IIT Kharagpur, India.
29. **S. Banerjee**, Semifluorinated poly(ether imide)s: High temperature low-k material (Invited talk), "*Polymer 2006*" 10-12 February 2006, IACS, Kolkata, India

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28. V. Kute, **S. Banerjee**, Synthesis and properties of semi fluorinated polyimides. Derived from bis 2,2-[4 {2'-trifluoromethyl 4'(4"-aminophenyl) phenoxy} phenyl] propane, *National Symp. on Eng. Polymers: Techno. and Appl.*, 18-19 December 2003, Coimbatore, India.
27. **S. Banerjee**, D. K. Jaiswal, Hyperbranched polyethers for chemical sensor applications, *DRDO Workshop on Adv. Polym. Mater.*, 16- 17 January 2003, DMSRDE, Kanpur.
26. **S. Banerjee**, A. K. Salunke, V. Kute, P. Shrivastava, D. K. Jaiswal, Novel hyperbranched poly(aryl ether) for chemical sensor applications, *DRDO Workshop on Adv. Polym. Mater.*, 16- 17 January 2003, DMSRDE, Kanpur.

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25. **S. Banerjee** Low dielectric constant polymers for microelectronics (Invited talk), *MACRO- 2002: Intern. Seminar on Frontiers of Polym. Sci.& Eng.*, 9-11 December 2002, Kharagpur, India.
24. V. Kute, **S. Banerjee**, Novel semifluorinated poly(ether imide)s derived from unsymmetrical trifluoromethyl monomer, *MACRO- 2002*, 9-11 December 2002, IIT Kharagpur, India.
23. M. K. Madhra, **S. Banerjee**, Novel high performance fluorinated polyimides: materials for advanced applications, *MACRO- 2002*, 9-11 December 2002, IIT Kharagpur, India.
22. A. K. Salunke, **S. Banerjee**, High performance PEEK's copolymers derived from 1,4-bis(4-fluoro-2-trifluoromethyl benzyl) benzene, *MACRO- 2002*, 9-11 December 2002, IIT Kharagpur, India.
21. V. Kute, **S. Banerjee**, Novel semifluorinated poly(ether imide)s derived from 4-aminobenzoxy-2'-trifluoromethyl-4'(4"-aminobenzenyl)benzene, *Fluoropolymer 2002: Current frontiers and future trends*, 13-16 October 2002, Savannah, Georgia, USA.
20. **S. Banerjee**, D. K. Jaiswal, Polymers in electronics (Invited talk), *National seminar on polymer: A smart material*, 14 September 2002, M.N.N.I.T, Allahabad.
19. M. K. Madhra, **S. Banerjee**, Novel fluorinated copolyimides, *National seminar on polymer: A smart material*, 14 September 2002, M.N.N.I.T, Allahabad.
18. A. K. Salunke, **S. Banerjee**, D.K. Jaiswal, Semifluorinated poly(aryl ether)s containing anthracene moiety in the backbone, *National seminar on polymer: A smart material*, 14 September 2002, M.N.N.I.T, Allahabad.
17. M. K. Madhra, **S. Banerjee**, Synthesis, Characterization and Evaluation of fluorinated poly (ether imide)s for low dielectric application in microelectronics, *National seminar on physics of material for electronic and Optoelectronic devices*, 25-27 February 2002, J. N. V. University, Jodhpur.

16. A. K. Salunke, **S. Banerjee**, Novel poly(arylene ether)s with pendent trifluoromethyl groups as low dielectric material for microelectronic applications, *National seminar on physics of material for electronic and Optoelectronic devices*, 25-27 February 2002, J. N. V. University, Jodhpur.

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15. **S. Banerjee**, G. Maier, C. Dannenberg, J. Springer, Gas permeabilities of polymers with pendent trifluoromethyl groups. 1: Poly(aryl ether)s, *Macro-2000, National Symposium on Polymers And Composite*, 1-2 December 2000, DMSRDE, Kanpur, India.

14. **S. Banerjee**, A. Salunke, M. Madhra, G. Maier, Novel Poly(arylene ether)s and Poly(ether imide)s With Pendent Trifluoromethyl Groups: Materials for Advanced Microelectronic / Structural Applications, *Macro-2000*, 1-2 December, DMSRDE, Kanpur, India.

13. G. Maier, **S. Banerjee**, High Temperature Polymers with Low Dielectric Constant for Advanced Microelectronics STEPI 5 Proceedings, 1999, Editions Technip, Paris.

12. K. D. Vyas, R. Asrey, A. Bhattacharya, **S. Banerjee**, R. V. Swamy, Development of piezoelectric crystal based CWA sensor and its use for studying the permeation of OP compound through PDMS membranes, *3rd International workshop on chemical and biological agents: Detection and decontamination*, 4-7 November 1998, Brono, Czech Republic.

11. **S. Banerjee**, G. Maier, M. Detelmaier, High Temperature dielectric polymers for microelectronics, *Werkstoffwoche*, 12-15 October 1998, Neue Messe Munich, Germany

10. G. Maier, **S. Banerjee**, R. Hecht, J. M. Schinder, Polyarylethers with pendent trifluoromethyl substituents as low dielectrics for microelectronics, *Fluoropolymer 98, ACS meeting*, 23-27 August 1998, Boston, USA.

9. **S. Banerjee**, M. Burger, G. Maier, Novel polyarylethers containing terphenyl moieties in the backbone and pendent trifluoromethyl groups, *Fluoropolymer 98, ACS meeting*, 23-27 August 1998, Boston, USA.

8. **S. Banerjee**, Ram Asrey, K. D. Vyas, A. Bhattacharya, Study of diffusion of dimethyl methylphosphonate through cured polydimethylsiloxane, natural rubber and nitrile rubber membranes using coated quartz piezoelectric sensor, *National seminar on polymer research in academy, industry and R & D*, 26-27 June 1998, Calcutta, India.

7. **S. Banerjee**, Polymers for gas separation (Invited talk), *Recent advances in synthesis & manufacturing processes of plastics, rubbers & fibers*, 13-14 March 1997, Indore, India.

6. L. Singh, K. V. Ramana, **S. Banerjee**, V. Dubey, R. S. Chauhan, Studies on bacterial cellulose membrane production and its structural properties, *National symposium on membrane in chemical and biochemical industries*, 16-17, February 1996, IIT, Delhi.

5. **S. Banerjee 1995** Polymers for protection against chemical warfare agents Intensive course on polymer materials, 10-12 March, SGSITS Indore, India.

4. **S. Banerjee 1995** Analysis of polymers Intensive course on polymer materials, 10-12 March, SGSITS Indore, India.

3. M. P. Kaushik, **S. Banerjee**, C. Saxena, P. C. Deb, R. V. Swami, Cockroach infestation and their control in Naval Ship INS Vikrant, *Workshop on under water system and engineering*, 17-18 August 1994, NSTL, Visakhapatnam, India.

2. S. Khatua, **S. Banerjee**, B. Adhikari, S. Maiti, Development of high performance polymer films, *27th Annual convention of chemist*, 26-30 December 1990, Magadg university, Bodh Gaya, India.

1. **S. Banerjee**, S. K. Palit, S. Maiti, Novel phosphorus containing polymers: synthesis and characterization, *27th Annual convention of chemist*, 26-30 December 1990, Magadg university, Bodh Gaya, India.

Ph.D. & Master thesis supervision(already completed / ongoing)**A. Ph. D. thesis (Supervision)**

28. Gopal Sahoo, Enrolled for Ph.D., **2019** (IIT Kharagpur).
27. Sambit Roy, Enrolled for Ph.D., **2018** (IIT Kharagpur).
26. Kajari Majumder, Enrolled for Ph.D., **2018** (IIT Kharagpur), jointly with Prof. Brigitte Voit from IPF, Dresden, Germany (*DAAD sandwich program*).
25. Swarup Krishna Bhattacharyya, Enrolled for Ph.D., **2018** (IIT Kharagpur), jointly Prof. Narayan Das.
24. Arijit Ghorai, Enrolled for Ph.D., **2017** (IIT Kharagpur).
23. Anwesa Mukherjee, Enrolled for Ph.D., **2017** (IIT Kharagpur), jointly with Prof. S. Basu Majumder.
22. Rimpa Chatterjee, Polyimides membranes for gas separation (Broad field of research), Ph.D. registration completed, **2017** (IIT Kharagpur).
21. Poushali Das, "*Bio-based luminescent carbon dots for sensor and biomedical applications*", Ph.D. awarded, **2019** (IIT Kharagpur), jointly with Prof. Narayan Das.
20. Anaparthi Ganesh Kumar "*Synthesis and Characterization of Bulky Groups Containing Semifluorinated Sulfonated Co-poly(ether imide)s for Proton Exchange Membrane Fuel Cell Application*", Ph.D. awarded, **2019** (IIT Kharagpur).
19. Sayantani Saha, "*Synthesis and Characterization of New Semifluorinated Sulfonated Co-Polytriazoles with Controlled Ion Exchange Capacity and Studies on their Proton Exchange Properties*" Ph.D. awarded, **2019** (IIT Kharagpur).
18. Arun Kumar Mandal, "*Phosphorus containing Proton exchange membranes*", Ph.D. awarded, **2019** (IIT Kharagpur).
17. Soumendu Bisoi, "*New cardo polyamide membranes for gas separation*", Ph. D. awarded, **2017** (IIT Kharagpur).
16. Asheesh Singh, "*New Fluorinated Sulfonated Polytriazoles and their Proton Exchange Membrane Properties*", Ph. D. awarded, **2017** (IIT Kharagpur).
15. Rajdeep Mukherjee, "*Cardo phenolphthalein based semifluorinated sulfonated poly(arylene ether sulfone)copolymers: Proton exchange membrane materials*", Ph. D. awarded, **2017** (IIT Kharagpur).
14. Sipra Ghosh, "*Synthesis, characterization and gas transport properties of cardo poly(arylene ether)s and poly(ether imide)s*", Ph. D. awarded **2016** (IIT Kharagpur).
13. Ershad Ali Mistri, "*Studies on proton exchange properties of semi-fluorinated sulfonated poly(ether imides)s*", Ph.D. awarded **2015** (IIT Kharagpur).
12. Debaditya Bera, "*Novel aromatic polyamides with bulky pendent groups and their gas transport properties*", Ph.D. awarded **2015** (IIT Kharagpur).
11. Partha Sarthi Bandyopadhyay (Supervisor) "*Fluorinated poly(ether amide)s for gas separation*" Ph.D. awarded **2015** (IIT Kharagpur).
10. Aruna Kumar Mohanty, "*Fluorinated sulfonated poly(arylene ethers)*", Ph.D. awarded **2014** (IIT Kharagpur).
9. Shyambo Chatterjee, "*New π -conjugated polymers and their application in photovoltaic devices*", Ph. D. awarded **2012** (IIT Kharagpur), (Jt. Supervisor: Prof. P. Banerji).

8. Barnali Dasgupta, “*Gas transport properties of indan and fluorene based fluorinated poly(ether imide) membranes*”, Ph. D. awarded **2011** (IIT Kharagpur).
7. Suman Kumar Sen, “*New cardo group containing fluorinated poly(ether imide)s and gas transport properties*”, Ph. D. awarded **2011** (IIT Kharagpur).
6. Samarendra Maji, “*Synthesis and characterization of new semi-fluorinated aromatic poly(ether amide)s for pervaporation application*”, Ph. D. awarded **2010** (IIT Kharagpur).
5. Anindita Ghosh, “*Synthesis and characterization of novel poly(ether-imide siloxane) copolymers and investigation of their properties*”, Ph. D. awarded **2009** (IIT Kharagpur).
4. Savita Gupta, “*Synthesis, characterization and formulation of stabilizers in PVC processing*”, Ph. D. awarded **2007** (Jiwaji Univ Gwalior), jointly with Prof. D.D. Agarwal.
3. Vijay Kute, “*Studies on semi fluorinated polyimides*”, Ph. D. awarded **2005** (Jiwaji Univ Gwalior), (Co-guide: Prof. S. Prabha).
2. Mukesh Kumar Madhra, “*Synthesis and characterization of novel high temperature, high strength poly(ether imide)s with pendent trifluoromethyl groups*”, Ph. D. awarded **2003** (Jiwaji Univ Gwalior), (Co-guide: Prof. S. Prabha).
1. Salunke Arun Kashinath, “*Synthesis of high temperature, Low dielectric constant poly(arylene ether)s with pendent trifluoromethyl groups*” Ph. D. awarded **2003** (Jiwaji Univ Gwalior), (Co-guide: Prof. S. Prabha).

B. Master Thesis (Supervision)

35. Vibhanshu Maurya, “*Effect of e-beam irradiation on crosslink density, physical, chemical and mechanical properties of TPU blends*”, awarded M. Tech. degree from IIT Kharagpur, **2020** in collaboration with Professor B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).
34. Chandan Mahapatra, “*Synthesis and Characterization of a Novel Phosphorus-Containing Poly(ether sulfone) and Its Blends with Bisphenol-A Based Poly(ether sulfone)*”, awarded M. Tech. degree from IIT Kharagpur, **2019**.
33. Ashish Singh, “*Surface Modification of Poly(ether imide) Materials to Enhance Their Superhydrophobicity*”, awarded M. Tech. degree from IIT Kharagpur, **2019**.
32. Sambit Roy, “*Synthesis and characterization of sulfonated polytriazole based proton exchange membrane fuel cell*”, awarded M. Tech. degree from IIT Kharagpur, **2018**.
31. Priyanka Sharan, “*Permeable polymersomes’ membrane for enzymatic reactions at neutral pH*”, awarded M. Tech. degree from IIT Kharagpur, **2018** in collaboration with Professor B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).
30. Kajari Mazumder, “*Preparation of high refractive index (HRI) polymer nanocomposite for better light outcoupling from OLED*”, awarded M. Tech. degree IIT Kharagpur, **2018** in collaboration with Professor B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).
29. Mercy Jatindro Sabar, “*MWCNT-poly(ether imide)s nanocomposites: Studies on electrical properties*”, awarded M. Tech. degree from IIT Kharagpur, **2017**.
28. Gargi Ghosh, “*Studies on polyimide siloxane block copolymers*”, awarded M. Tech. degree from IIT Kharagpur, **2017**.
27. Sumanta Samanta, “*Preparation and characterization of conducting polymer nanocomposites with improved thermoelectric efficiency*”, awarded M. Tech. degree IIT Kharagpur, **2017** in collaboration with Professor B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).

26. Agniva Dutta, "*Synthesis and characterization of novel poly(ether imide)s prepared from a diamine with a propeller triphenyl amine core*", awarded M. Tech. degree from IIT Kharagpur, **2016**.
25. Shamila Firdaus, "*Glyco-pseudodendrimers on a polyester basis: Synthesis and investigation of protein-pseudodendrimer interaction*", awarded M. Tech. degree from IIT Kharagpur, **2016** in collaboration with Prof. B. Voit from TU Dresden & IPF Dresden, Germany (*DAAD sandwich program*).
24. Ashish Jadav, "*Expanded graphite/cellulose nano-crystal/thermoplastics polyurethane (TPU) composite*", awarded M. Tech. degree from IIT Kharagpur, **2015** in collaboration with Prof. B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).
23. Rimpa Chatterjee, "*Synthesis and characterization of new semifluorinated cardo poly(ether imide)s*", awarded M. Tech. degree from IIT Kharagpur, **2015**.
22. Vignesh Kumar S., "*Self-crosslinking hyperbranched polyarylethers and their nanocomposites*", awarded M. Tech. degree from IIT Kharagpur, **2014** in collaboration with Prof. B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).
21. Anaparthi Ganesh Kumar, "*Triphenyl moiety containing non-fluorinated sulfonated aromatic polyimides for proton exchange membrane*" awarded M. Tech. degree from IIT Kharagpur, **2014**.
20. Sayantani Saha, "*New fluorinated poly(arylene ether)s*", awarded M. Tech. degree from IIT Kharagpur, **2014**.
19. Preetom Sarkar, "*Synthesis and characterization of novel sulfonated poly(ether imide)s for proton exchange membrane*", awarded M. Tech. degree from IIT Kharagpur, **2013** in collaboration with Dr. Santanu Chattopadhyay (RTC, IIT Kharagpur).
18. Tapas Koley, "*Semi fluorinated new aromatic poly(ether imide)s: Synthesis, Characterization & properties*", awarded M. Tech. degree from IIT Kharagpur, **2013**.
17. Arunjunai Raja Shankar S., "*Functionalized grapheme derivatives and their TPU nanocomposites by in-situ polymerization technique*", awarded M. Tech. degree from IIT Kharagpur, **2012** in collaboration with Prof. B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).
16. Asheesh Singh, "*Studies on emulsion polymerization of acrylic monomers to control particle morphology and its impact in paint properties*", awarded M. Tech. degree from IIT Kharagpur, **2012** in collaboration with Tapan K Dhar from Asian Paints.
15. Jasjeet Singh Kang, "*Synthesis and characterization of new fluorine and carbazole based copolymers for their possible application in polymer solar cell*", awarded M. Tech. degree from IIT Kharagpur, **2012**.
14. Sourav Chakraborty, "*Preparation of polysulfone-multi walled carbon nanotube composite and synthesis of sulfonated polysulfone and its thermal behavior*", awarded M. Tech. degree from IIT Kharagpur, **2011** in collaboration with Prof. B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).
13. Hirak Satpathi, "*Synthesis and characterization of new semifluorinated linear and hyperbranched poly(arylene ether phosphine oxide)s from B₂ and AB₂ type monomers*", awarded M. Tech. degree from IIT Kharagpur, **2010** in collaboration with Prof. B. Voit from TU Dresden & IPF Dresden, Germany, (*DAAD sandwich program*).
12. Debaditya Bera, "*Synthesis, characterization and properties of novel semifluorinated organo-soluble aromatic polyamides*", awarded M. Tech. degree from IIT Kharagpur, **2010**.
11. Arun K. Mohanty, "*Synthesis and characterization and properties of new semi fluorinated poly(arylene ether)s containing phthalimidine moiety in the main chain*", awarded M. Tech. degree from IIT Kharagpur, **2009**.
10. Kapil Pareekh, "*Synthesis and characterization and properties of new fluorinated poly(imide siloxane) copolymers from 4,4'-(hexafluoro-isopropylidene) diphtalic anhydride*", awarded M. Tech. degree from IIT Kharagpur, **2009**.

9. Rohit Srivastav, "***In-situ preparation of polyimide composites based on functionalized carbon nanotubes***", awarded M. Tech. degree from IIT Kharagpur, **2008** in collaboration with Prof. B. Voit from TU Dresden & IPF Dresden, Germany, (***DAAD sandwich program***).
8. Mohit Agarwal, "***New poly (arylene ether)s containing phenolphthalein anilide***", awarded M. Tech. degree from IIT Kharagpur, **2008**.
7. Praveen Swai, "***Electromagnetic interference shielding effectiveness of conductive graphite filled Polypropylene and PEI based composites***" awarded M. S. in Materials Science and Engineering from IIT Kharagpur, **2008**.
6. Samit Khan, "***Development of clay reinforced unsaturated polyester, vinyl ester based nanocomposites***" awarded M. Tech. degree from IIT Kharagpur, **2007**.
5. Anjali Digal, "***Synthesis and characterization of novel poly(arylene ether)s***", awarded M. Tech. degree from IIT Kharagpur, **2007**.
4. Nidhi Sood, "***Synthesis and characterization of novel semifluorinated poly(arylene ether)s***" awarded master of science in Applied Chemistry in **2003** from Devi Ahilya Vishwavidyalaya, Indore.
3. Pritul Srivastav, "***Synthesis and characterization of hyperbranched fluorinated poly(aryl ether)***", awarded M.Sc. in Applied Chemistry in **2001** from Rajiv Gandhi Proudlyogiki Vishwavidyalaya, Bhopal.
2. Neerja Dwivedi, "***Studies on SiO₂ filled BTDA-ODA polyimide***", awarded M.Sc. in Applied Chemistry in **2001** from MIT, Gwalior.
1. Shevya Agarwal, "***Effect of silica filler in polyimides from 6-FDA and ODA***", awarded M.Sc. in Applied Chemistry in **2001** from MIT, Gwalior.

Scientific research /Translational research**A. Scientific research****i) Novel low dielectric constant materials for microelectronic applications:****a) Approach 1: Through linear polymeric materials: Low dielectric constant (~ 2.6)**

Next-generation microelectronic packing requirements drive the need to produce increasingly lower constant dielectric materials while maintaining high thermal stability and ease of processing. Efforts have been focused on the direction of synthesis, characterization and property evaluation of new polymers with the goals of high thermal stability ($T_d \geq 500$ °C) and isothermal stability at 350 °C for several hours in the air, high mechanical strength, low water absorption rate (< 1 %), solubility in selected organic solvents, low dielectric constants (< 2.5) and low coefficients of thermal expansion. All these stringent parameters were achieved by preparing novel poly(arylene ether)s and poly(ether imide)s containing rigid terphenyl / quadriphenyl units in the polymer backbone and pendent trifluoromethyl groups. Candidate materials [poly(ether imide)s] exhibited outstanding thermo-oxidative stability up to 534 °C for 5 % weight loss, tensile strength up to 120 MPa, tensile modulus 2.54 GPa and elongation at break up to 72 % depending upon the polymer structures and precise, repeating units. The poly(arylene ether)s are highly soluble in a wide range of organic solvents, whereas the poly(ether imides) exhibited solubility in selected solvents. The polymers showed a negligibly small water absorption rate (0.3 %) even after submersion in boiling water for several days, low dielectric constant (~ 2.6), and have optical clarity. These values indicate that the candidate materials can be considered for use in numerous applications which requires robust organic materials including composites and precursors for high-performance aerospace materials as well as interlayer dielectric materials for advanced microelectronic applications. [*Macromolecules* **32** (1999) 4279-4289; *Chemistry of Materials* **11** (1999) 2179-2184; *Polymer* **44** (2003) 613-622; *J. Appl. Polym. Sci.* **103** (2007) 3025-3044]

b) Approach 2: Through hyperbranched polymeric materials: Very low dielectric constant (~ 2.2)

The preparation of low dielectric constant polymeric materials from linear poly(arylene ether)s and poly(ether imide)s were successful with all the desired properties required. However, the reduction of dielectric constant was not possible below 2.8. The hyperbranched polymers are a relatively new class of macromolecules that have gained significant attention from both academia and industry. These highly branched structures generate intrinsically void space, and that helps in a reduction in dielectric constant. With this approach new **AB₂** monomers [e.g. 3,5-bis-(4-fluoro-3-trifluoromethylphenyl) phenol] were prepared. These monomers led to high molecular weight hyperbranched polymers by self-condensation reaction. A new synthetic approach was taken to prepared hyperbranched polymers by condensing the **AB₂** monomer with different diphenols (**A₂**) in different molar ratios. This novel approach resulted in high yield (71 - 91 %), and the 2:1 molar products of **AB₂/A₂** showed extremely high weight average molecular weights of 3730000 and 4470000 g/mol without any gelation under the specified reaction conditions. The self-condensed hyperbranched poly(arylene ether)s showed a glass transition temperature (T_g) as high as 199 °C and a 10% weight loss temperature as high as 573 °C in N₂. Whereas the 2:1 molar products of **AB₂/A₂** did not show T_g up to 350 °C, and the 10% weight loss temperature was around 550 °C. Thin films of the hyperbranched polymers were prepared on silicon wafers via spin-coating. Smooth surfaces were obtained without any detectable feature indicating a good film quality. The water contact angle value of the thin films indicates that the hyperbranched polymers are hydrophobic. The dielectric constant values of these hyperbranched polymers as measured were within 2.2-2.4. High hydrophobicity of the polymers combined with high thermal stability, good film-forming ability, and low dielectric constant renders these materials highly interesting for microelectronics in the field of the low dielectric constant coating. [*J. Polym. Mater.* **24** (2008) 247-254; *Macromol. Chem. Phys.* **210** (2009) 1272-1282; *Macromolecules*, Vol. **43** (2010) 2846-2854; *Eur. Polym. J.* **47** (2011) 196-207]

c) Approach 3: Through electro-spinning: Ultra low dielectric constant (1.4)

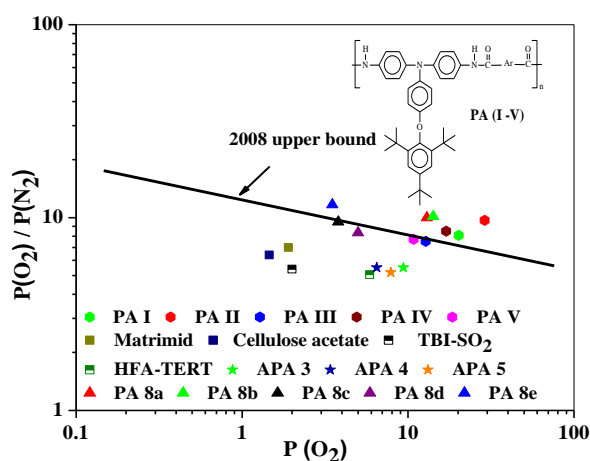
Polyimides as a polymer class cover a comprehensive property range, from very high-melting wholly aromatic polyimides to melt-processable polymers. Among various polymers studied with electrospinning, polyimides have been very interesting because they constitute an important class of polymers due to their superior thermal and chemical resistance, as well as mechanical properties that can be used in various fields. The goal of this present section of work was to prepare polyimide electro-spun nanofibers from the previously reported polyimides and investigation of their properties. The proper combination of material (i.e. fluorinated polyimides) and the processing technique (electrospinning) lead to the formation of polyimides with low dielectric constant, high thermo-oxidative stability, and glass transition temperature and high hydrophobicity. The polyimides in this work were based on 4,4'-bis [3'-trifluoromethyl-4' (4'-amino benzoxy) benzyl] biphenyl and various fluorinated and non-fluorinated

dianhydrides like benzene-1,2,4,5-tetracarboxylic dianhydride (PMDA), 3,3',4,4'-biphenyltetracarboxylic dianhydride (BPDA), benzophenone-3,3',4,4'-tetracarboxylic dianhydride (BTDA) and 4,4'-(hexafluoroisopropylidene) diphthalic anhydride (6FDA). Processing of the polyimides was done in poly(amic acid) stage by two different methods – electrospinning and solution casting for comparison purposes. The processing of polyimides by electrospinning led to enhancement in mechanical properties (anhydride structure dependent) and hydrophobicity without sacrificing thermo-oxidative stability and glass transition temperatures significantly. Also, low dielectric constants (as low as 1.43) attained by a suitable combination of dianhydride (6FDA) with 4, 4-bis [3'-trifluoromethyl-4' (4'-amino benzoxy) benzyl] biphenyl diamine. [*Polym. Adv. Technol.* 23(2012)951-957]

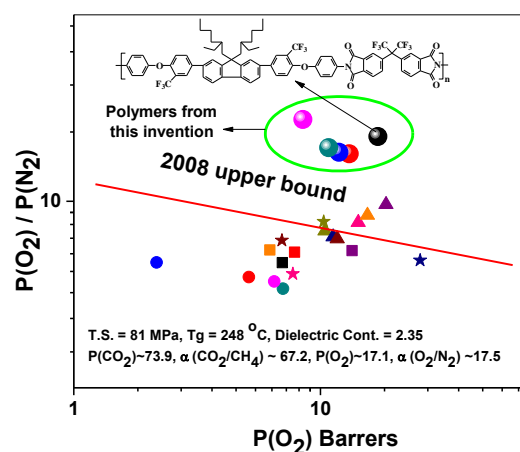
ii) Membrane based separation

a) High –performance polymer membranes for gas separation application: Surpass the latest upper boundary limit drawn by L. M. Robeson.

Hundreds of polymers investigated so far as potential membrane materials; only a few found actual applications in industrial gas separating plants. It is a long way from a polymer that showed a right combination of permeability and selectivity to the industrial use of membranes based on it. The requirements for the production of robust gas separation membranes include sufficiently good mechanical and film-forming properties, thermal and chemical stability under the conditions of the separation process, and absence of aging in thin films (reduction of permeability in time). Wholly aromatic polyimides and polyamides are good candidates because of their number of outstanding properties. However, this class of polymers suffers from their limited solubility and intractability in their full imide form that renders processing difficulties. Our research aims to prepare processable polyimides (PIs) and polyamides (PAs) without sacrificing their set of outstanding properties. They have the right balance between gas permeability and selectivity for a pair of gas. Accordingly, a large number of semi-fluorinated PIs and PAs have been prepared with cardo moieties in the polymer backbone to draw an optimized blueprint for polymer structure versus properties. The non-porous membranes prepared using these polymers have been investigated for their gas separation performance. The polymers showed outstanding thermal stability ($T_d \sim 559$ oC), high glass transition temperature ($T_g \sim 335$ oC), high tensile strength (~ 102 MPa), and both high gas permeability and gas selectivity for a pair of gases. The PIs prepared from 6FDA showed the highest permeability coefficient for all the gases ($P_{CO_2} = 71.32$, $P_{O_2} = 25.37$) whereas BPADA based polymer exhibited the highest permselectivity ($CO_2/CH_4 \sim 37.17$ and $O_2/N_2 \sim 8.36$); staying closer/ surpassed to the latest upper boundary limit drawn by L. M. Robeson. [*J. Membr. Sci.* 343 (2009) 97-103; *J. Membr. Sci.* 345 (2009) 249-256; *J. Membr. Sci.* 350 (2010) 53-61; *J. Membr. Sci.* 364 (2010) 211-218; *J. Membr. Sci.* 365 (2010) 329-340; *J. Membr. Sci.* 362 (2010) 58-67; *Macromolecules* 48 (2015) 4541-4554; *Patent Appl. No.* 782/KOL/2015; *J. Membr. Sci.* 365 (2016) 172-182; *Polym. Chem.* 8 (2017) 4220-4232; *J. Membr. Sci.* 522 (2017) 77-90; *ACS Omega* 3 (2018) 13510-13523; *Sep. Purif. Tech.* 217 (2019) 183-194].



Macromolecules, 48 (2015) 4541-4554



J. Membr. Sci. 497 (2016) 172-182;
Patent Appl. No. 782/KOL/2015

b) New poly(ether amide)s for pervaporation application : Benzene selective membrane material, ever achieved highest pervaporation separation index (PSI)

Aromatic polyamides have received considerable attention because of their outstanding thermal stability, chemical resistance, and mechanical properties. However, their applications are restricted because of their poor solubility in organic solvents and too high glass transition temperatures that make them very difficult to be processed by spin coating or thermo-forming techniques. We have incorporated both fluorine and flexible ether linkages by

designing new diamine monomers that resulted in poly(ether amide)s when reacted with several diacids. The tailored polymers showed excellent thermal stability associated with high glass-transition temperatures (230-290 oC), good mechanical strength, and preferential solubility in organic solvents. The dense membranes were fabricated and used for pervaporation separation of benzene/cyclohexane mixture. The study indicates that the membranes are Bz selective with separation factor as high as 7.1, the normalized flux as high as 27.31 kg μm^2 h, and showed the highest pervaporation separation index (PSI) value (3782 g/m² h). Besides these, in general, the low activation energy, as was calculated from the temperature dependence permeation study indicated the suitability of these polymers for pervaporation separation of Bz/Chx mixture in large scale operation. This study gives a direction that what structural modifications in polymer structure to improve both flux and separation factor, while not sacrificing the other physical properties. [*Sep. & Puri. Tech.* **70** (2009) 128-135; *J. Membr. Sci.* **349** (2009) 145-155; *J. Membr. Sci.* **360** (2010) 380-388]

c) New membrane materials for fuel cell application

Prof. Banerjee and his group have developed several classes of high-performance polymers and membranes thereof by designing new monomers and polymers. His work on the development of new proton exchange membrane material is highly remarkable. He has nicely demonstrated new PEMs with improved membrane performance in terms of oxidative/hydrolytic, thermal and mechanical stability, water uptake, and proton conductivity compared to commercial Naffion® PEM materials. [*J. Membr. Sci.* **409/410** (2012) 145-155; *J. Membr. Sci.* **411/412** (2012) 117-129; *J. Membr. Sci.* **435** (2013) 145-154; *Ind. & Eng. Chem. Res.* **52** (2013) 2772-2783; *J. Membr. Sci.* **441** (2013) 168-177; *J. Membr. Sci.* **435** (2013) 145-154; *RSC Advances* **4** (2014) 11848-11858; *RSC Adv.* **4** (2014) 22398-22410; *RSC Adv.* **4** (2014) 46723-46736; *Membr. Sci.* **469** (2014) 225-237; *Solid State Ionics* **254** (2014) 82-91; *Eur. Poly. J.* **60** (2014) 235-246; *Eur. Poly. J.* **73** (2015) 466-479; *RSC Adv.* **6** (2015) 13478-13489; *Mater. Chem. Phys.* **181** (2016) 265; *RSC Adv.* **6** (2016) 13478; *J. Membr. Sci.* **510** (2016) 497-509; *Eur. Poly. J.* **83** (2016) 114-128; *New J. Chem.* **41** (2017) 6849-6856; *Eur. Polym. J.* **95** (2017) 581-595; *Eur. Polym. J.* **103** (2018) 322-334; *ACS Appl. Mat. Interfaces* **10** (2018) 14803-14817; *Inorg. Chem. Front.* **3** (2019) 184-191; *ACS Appl. Polym. Mater.* **1** (2019) 893-905; *Eur. Polym. J.* **118** (2019) 451-464; *Chem. Asian J.* **14** (2019) 4389-4394; *J. Polym. Sci.* **58** (2020) 263-279].

d) Photoluminescent nanoparticles:

Photoluminescent nanoparticles especially, carbon dots, have been prepared from natural sources using green synthetic route. The materials were investigated for environmental and biological applications such as heavy-metal sensing, bio labeling, drug delivery, targeted cancer therapy, in vitro and in vivo experiments, and light-emitting polymer composites. [*J. Photochem. Photobiol. B.* **197** (2019) 111545; *Mater. Chem. Phys.* **237** (2019) 121860; *Colloids and Surfaces A.* **579** (2019) 123604; *Int. J. Biol. Macromol.* **132** (2019) 316-329; *New J. Chem.* **43** (2019) 6205-6219; *Luminescence* **33** (2018) 1136-1145; *J. Photochem. Photobiol. B: Bio.* **180** (2018) 56-67; *Sensor. Actuat. B-Chem.* **266** (2018) 583-593; *Mater. Sci. Eng. C* **88** (2018) 115-129; *Nanotechnology* **28** (2017) 19550].

B. Product / Technology Development

- Development of slow-release insecticidal paint
- Quartz Crystal-based Piezoelectric sensor for detection of chemical warfare (CW) agents
- Development of new materials for spherical carbon
- In-house Kapton film development
- Development of Siltem copolymer
- Development of face mask for defence application
- Development of high molecular weight PMMM for e-beam lithography
- Developed new membrane materials for efficient gas separation
- Development of CNT-epoxy nanoparticle based fractional capacitor
- Development new SILTEM copolymers for high temperature, radiation shield cable application
- Developed new proton exchange membranes for fuel cell applications
- Development of low voltage electrowetting-on-dielectric (EWOD) actuation using nanocomposite thin film
- Developed PI-PDMS membrane (10-20 microm) for IMS based chemical agent monitor for detection of CW agents.