

Gulzar Ahmad Bhat

Centre for Interdisciplinary
Research and Innovations
University of Kashmir
Srinagar, J&K 190001

gulzar@tamu.edu
cell: 600.644.0334

Education and appointments

- 2021 – Present** **University of Kashmir (Srinagar, J&K, India)**
Ramanujan Faculty Fellow
- 2018 – 2021** **Texas A&M University (College Station, Texas, USA)**
Postdoctoral Research Associate
Advisor: Donald J. Darensbourg
Research Areas:
- Synthetic approaches for developing sustainable polymers from the catalytic coupling of carbon-dioxide and epoxides.
 - Incorporation of metallo-chain transfer agents into polycarbonates and polymonothiocarbonates for prospective micellar catalysis.
- 2012 – 2018** **Indian Institute of Technology Bombay (Mumbai, India)**
Ph.D., Chemistry
Advisor: Prof. Ramaswamy Murugavel
Thesis title: Synthetic and Materials Chemistry Aspects of Metal Monoalkyl and Monoaryl Phosphates
- 2009 – 2011** **University of Kashmir, Srinagar Jammu and Kashmir**
M.Sc., Chemistry

Research experience

Postdoctoral Research: Texas A&M University (Advisor: Donald J. Darensbourg, Oct 2018-present)

This research focuses on synthesis and functionalization of different copolymers derived from CO₂/COS with epoxides. In order to further increase the utility of these polymers different discrete metal complexes were introduced in each chain using different metallo-chain transfer agents during the copolymerization of CO₂/COS with epoxides. Our initial studies in this area have involved the utilization of metal carbonyl diols which serve as CTAs. Further we have extended our investigation on dicarboxylic acid chain-transfer agents which contain discrete metal binding sites. We have also synthesized branched sulfur containing polymers and currently we are working on conducting TEMPO based polymers.

- A novel approach for introducing a single metal complex into a polymer chain. metallo-chain transfer agents in CO₂ or COS/epoxide copolymerization processes.
- Placing single metal complexes into the backbone of CO₂-based polycarbonate chains, construction of nanostructures for prospective micellar catalysis.
- Synthesized well defined branched sulfur containing copolymers via one pot strategy.
- Mentored three undergraduate research students and one visiting graduate student.

Research Associate: Indian Institute of Technology Bombay Mumbai (Advisor: Prof. R. Murugavel, March 2018 – September 2018)

This research focuses on the synthesis and characterization of dinuclear cyclo(metallo)phosphates and further explored their catalytic activity in alcohol oxidation reactions.

- Dinuclear manganese(II), cobalt(II), and nickel(II) aryl phosphates incorporating 4'-chloro-2,2':6',2''-terpyridine coligands – efficient catalysts for alcohol oxidation

Graduate Research: Indian Institute of Technology Bombay Mumbai (Advisor: Prof. R. Murugavel, January 2012 – February 2018)

This research addresses the issues of stabilization of monoalkyl phosphates and production of multi-gram quantities of $(RO)P(O)(OH)_2$ ($R = Me, Et, iPr$ and tBu). These monoalkyl phosphates were later reacted with various transition metal precursors which preferentially lead to the formation of 2D layered solids. These low dimensional materials were further delaminated to single-layer nanosheet by a facile and rapid solvent assisted method. These compounds have intrinsic ability to act as single source precursors for different ceramic phosphates. The catalytic and electrochemical properties were also further explored.

- Facile exfoliation of single-crystalline copper alkylphosphates to single-layer nanosheets and enhanced super capacitance.
- Synthesized thermolabile organotitanium monoalkyl phosphates and further explored their utility as epoxidation catalysts and single-source precursors for TiP_2O_7 .
- Synthesized and structurally characterized dimeric and polymeric copper organophosphates and further probed their DNA cleavage and cytotoxic activity.
- Synthesized and structurally characterized spirocyclic lanthanide organophosphate polymers and explored their magnetic properties.

Teaching experience

- 2013-2014 Teaching Assistant for General Chemistry Course (CH107L IIT Bombay). In this course B.Tech students are taught different separation techniques. This course is offered to all undergraduate students at Indian Institute of Technology Bombay Mumbai during their first year.
- 2014-2015 Teaching Assistant for Inorganic Chemistry Course (CH419L, IIT Bombay). In the course my responsibilities were to teach the new M.Sc. entrants how to separate different binary and ternary mixtures chromatographically. The final composition was further determined by gravimetric analysis. This course is offered to all new M.Sc. entrants to Chemistry Department, Indian Institute of Technology Bombay and run during autumn semester.

Publications

21. **Bhat, G. A.**; Rashad, A. Z.; Ji, X.; Quiroz, M.; Fang, L.; Darensbourg, D. J.; TEMPO Containing Radical Polymonothiocarbonate Polymers with Regio- and Stereo-Regularities: Synthesis, Characterization, and Electrical Conductivity Studies *Angew. Chem. Int. Ed.*, **2021**, asap DOI: 10.1002/anie.202108041
20. Verma, S; **Bhat, G. A.**; Murugavel, R., Cyclopentadienyl Removal Assisted Nuclearity Expansion in Thermolabile Titanium and Zirconium Organophosphates Sourced from Metallocene Dichlorides *J. Organomet. Chem.*, **2021**, 932, 121642

19. **Bhat, G.A.**; Darensbourg, M.Y.; Darensbourg, D.J., Copolymerisation of Propylene Oxide and $^{13}\text{CO}_2$ to Afford Completely Alternating Regioregular ^{13}C -Labelled Poly(propylene carbonate). *Polymer Journal* **2021**, 53, 215-218
18. **Bhat, G. A.**; Murugavel, R., Dinuclear Group 12 Phosphates Bridged by Hexadentate 2,3,5,6-Tetra(2-pyridyl)-pyrazine and their Supramolecular Organization *J. Mol. Struct.*, **2021**, 1224, 128960.
17. **Bhat, G. A.**; Luo, Ming.; Darensbourg, D. J., Catalysis of Carbon Dioxide and Oxetanes to Produce Aliphatic Polycarbonates *Green Chem.*, **2020**, 22, 7707-7724
16. **Bhat, G. A.**; Rashad, A. Z.; Darensbourg, D. J., Synthesis of Terpyridine-Containing Polycarbonates with Post polymerization Providing Water-Soluble and Micellar Polymers and Their Metal Complexes *Polym. Chem.*, **2020**, 11, 4699-4705
15. **Bhat, G. A.**; Murugavel, R., Single-4-Ring Zinc Organophosphate Based Expanded Ditopic N,N'-Metalloligands. *J. Chem. Sci.*, **2020**, 132, 121
14. Yue, T. J.; **Bhat, G.A.**; Zhang, W.J.; Ren, W. M.; Lu, X. B., Darrensbourg, D.J., Facile Synthesis of Well-Defined Branched Sulfur-Containing Copolymers via a "One-pot" Copolymerization of Carbonyl Sulfide and Epoxide. *Angew. Chem. Int. Ed.*, **2020**, 59, 13633-13637.
13. Wahid, M.; Patel, M.; Haroon, H.; Kumar, A.; **Bhat, G. A.**; Majid, K.; Putthusseri, D.; Ahmad, J.; Lone, S. High Na^+ Mobility in rGO Wrapped High Aspect Ratio 1D SbSe Nano Structure Renders Better Electrochemical Na^+ Battery Performance. *ChemPhysChem.*, **2020**, 21, 814-820.
12. **Bhat, G. A.**; Rashad, A. Z.; Folsom, T. M.; Darensbourg, D. J., Placing single metal complexes into the backbone of CO_2 -based Polycarbonate Chains, Construction of Nanostructures for prospective Micellar Catalysis. *Organometallics*, **2020**, 39, 1612-1618.
11. Folsom, T. M.; **Bhat, G. A.**; Rashad, A. Z.; Darensbourg, D. J., Approach for Introducing a Single Metal Complex into a Polymer Chain: Metallo-Chain Transfer Agents in CO_2 or COS/Epoxide Copolymerization Processes. *Macromolecules*, **2019**, 52, 5217-5222.
10. **Bhat, G. A.**; Haldar, S.; Verma, S.; Chakraborty, D.; Vaidhyanathan, R.; Murugavel, R., Facile Exfoliation of Single-Crystalline Copper Alkylphosphates to Single-Layer Nanosheets and Enhanced Supercapacitance. *Angew. Chem. Int. Ed.*, **2019**, 58, 16844-16849.
9. **Bhat, G. A.**; Verma, S.; Rajendran, A.; Murugavel, R., Thermolabile Organotitanium Monoalkyl Phosphates: Synthesis, Structures, and Utility as Epoxidation Catalysts and Single-Source Precursors for TiP_2O_7 . *Inorg. Chem.*, **2018**, 57, 7644-7654.
8. **Bhat, G. A.**; Rajendran, A.; Murugavel, R., Polydentate 4-Pyridyl-terpyridine Containing Discrete Cobalt Phosphonate and Polymeric Cobalt Phosphate as Catalysts for Alcohol Oxidation. *Z. Anorg. Allg. Chem.*, **2018**, 644, 692-699.
7. **Bhat, G. A.**; Rajendran, A.; Murugavel, R., Dinuclear Manganese(II), Cobalt(II), and Nickel(II) Aryl Phosphates Incorporating 4'-Chloro-2,2':6',2''-Terpyridine Coligands - Efficient Catalysts for Alcohol Oxidation. *Eur. J. Inorg. Chem.*, **2018**, 2018, 795-804.

6. **Bhat, G. A.**; Maqbool, R.; Murugavel, R., Synthesis, characterisation, nuclease and cytotoxic activity of phosphate-free and phosphate-containing copper 4'-(N-methylpyridinium)-2,2':6',2'' terpyridine complexes. *J. Chem. Sci.*, **2018**, *130*, 21
5. Gupta, S. K.; **Bhat, G. A.**; Murugavel, R., Lanthanide Organophosphate Spiro Polymers: Synthesis, Structure, and Magnetocaloric Effect in the Gadolinium Polymer. *Inorg. Chem.*, **2017**, *56*, 9071-9083.
4. **Bhat, G. A.**; Maqbool, R.; Dar, A. A.; Ul Hussain, M.; Murugavel, R., Selective formation of discrete versus polymeric copper organophosphates: DNA cleavage and cytotoxic activity. *Dalton Trans.*, **2017**, *46*, 13409-13420.
3. **Bhat, G. A.**; Kalita, A. C.; Murugavel, R., Intriguing structural chemistry of neutral and anionic layered monoalkylphosphates: single-source precursors for high-yield ceramic phosphates. *CrystEngComm.*, **2017**, *19*, 5390-5401.
2. Dar, A. A.; **Bhat, G. A.**; Murugavel, R., Dimensionality Alteration and Intra- versus Inter-SBU Void Encapsulation in Zinc Phosphate Frameworks. *Inorg. Chem.*, **2016**, *55*, 5180-90.
1. **Bhat, G. A.**; Vishnoi, P.; Gupta, S. K.; Murugavel, R., Anhydrous manganese hypophosphite dense framework solid: Synthesis, structure and magnetic studies. *Inorg.Chem. Commun.*, **2015**, *59*, 84-87.

Books

Bhat, G. A.; Darensbourg, D. J., A contribution to a book on Sulfur-Containing Polymers: From Synthesis to Functional Materials. Chapter 2: Carbon Disulfide Derived Polymers (Wiley-VCH: **2021**, 39-79)

Bhat, G. A.; Darensbourg, D. J., A contribution to a book on Polymerization of Epoxides (ACS publishers) under Review.

Selected Presentations

Aug. 2019	American Chemical Society National Meeting (San Diego, CA; Poster Presentation)
July. 2019	Polymers for Advanced Technologies Conference (Texas A&M University, Texas, Oral Presentation)
May 2017	28 th Annual meeting of Materials Research Society of India (IIT Bombay, Mumbai India Poster Presentation)
Mar 2017	In-house Symposium Department of Chemistry (IIT Bombay, Powai Mumbai India; Flash Presentation).
June 2016	16 th International Conference on Polymers and Organic Chemistry (Creta Maris, Beach Greece; Poster Presentation).
Aug 2015	Chemical Frontiers 2015 (Goa, India ; Poster Presentation).
Dec 2015	International Symposium on Modern Trends in Inorganic Chemistry(Jadavpur University, Kolkata India ; Oral Presentation).

Honors and awards

- 2021 Prestigious Ramanujan Fellowship Award from DST-SERB Govt. of India.**
- 2016 Best Poster Award in international conference on polymers and organic Chemistry (POC-16) held in Greece. (<http://blogs.rsc.org/qm/2016/07/23/congratulations-on-poc-16-poster-prize-winners/>).
- 2016 Travel Award from IIT Bombay for attending International Conference in Greece.
- 2014 Senior Research Fellowship from University Grants Commission India.
- 2010 National Eligibility award University Grants Commission (UGC)/Council of Scientific and Industrial Research (CSIR) India Selected under Junior Research Fellowship (UGC- JRF) scheme.
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Outreach

- April 2019 Science Night at Sul Ross Elementary School (Presenter)
Oct 2018 Chemistry Open House at Texas A&M University (Presenter)
Feb 2015 TechConnect at Nehru Science Centre (Presenter)
Jan 2014 Magic in Chemistry show at IITB for Junior students (Presenter)
Dec 2013 Techfest at IITB for Junior students (Presenter)
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Other

Mentoring

- Hamza Mohammad (Undergraduate Student, Texas A&M University, Dec 2019-july 2021)
Ryan Rutledge (Undergraduate Student, Texas A&M University, May 2019-May 2020; Currently working with Clinical Pathology Laboratories, USA)
- Ahmed Z. Rashad (Visiting Undergraduate Student, Texas A&M University, January 2019 – January 2020; Currently MS student at University of Calgary, Alberta, Canada)
- Tucker Folsom (Undergraduate Student, Texas A&M University, October 2018-May 2019); Currently graduate student at California Institute of Technology USA
- Vishal Singh (Undergraduate summer intern at IITB from “Banaras Hindu University” Varanasi, India (May 2018- July 2018)
- Deepak Sharma (Masters Student from Department of Chemistry IITB Powai Mumbai India from May 2017 to April 2018)
- Gaurav Khurana (Masters Summer Intern student from Department of Chemistry Indian Institute of Technology Kanpur, India May 2015 to July 2015)

Sonam Verma (Graduate student Department of Chemistry IITB Powai Mumbai India, Jan 2014 to Aug 2017)

Service Postdoctoral Association of Chemistry (PAC), Texas A&M University, President (July 2019 – present)

Professional Affiliations Current Member American Chemical Society (ACS) (2014 – Present)
Lifetime Member of Chemical Research Society of India (CRSI)(2016 – Present)
Associate Member of Royal Society of Chemistry (AMRSC)(2015-2017).

References

Professor Donald J. Darensbourg

Department of Chemistry
Texas A&M University
College Station, TX 77842
djdarens@chem.tamu.edu
+1 979-845-5417

Professor Marcetta Darensbourg

Department of Chemistry
Texas A&M University
College Station, TX 77842
marcetta@chem.tamu.edu
+1 979-229-3370

Professor R. Murugavel

Department of Chemistry
Indian Institute of Technology
Bombay, Mumbai, India 40076
rmv@chem.iitb.ac.in
+91 982-080-3249

Professor Prasenjit Ghosh

Department of Chemistry
Indian Institute of Technology
Bombay, Mumbai, India 40076
pghosh@chem.iitb.ac.in
+91 222-576-7178