विद्यया विन्दते अमृतं

Poornaprajna Institute of Scientific Research

BENGALURU

Promoted & managed by Admar Mutt Education Foundation

Recognised by Dept. of Scientific & Industrial Research, GOI and Maniapal University

ANNUAL REPORT

PPISR

2015 - 16

विद्यया विन्दते अमृतं

Poornaprajna Institute of Scientific Research
Bengaluru, India

Annual Report 2015-2016

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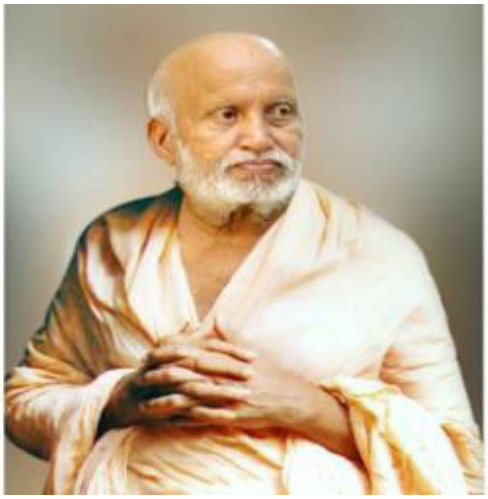
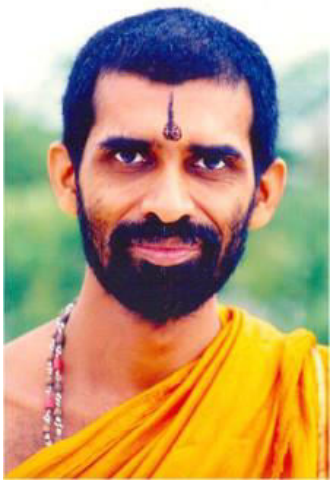
Founder's Message



Knowledge is Power! Providing facilities to do research in the Pure Sciences has become very necessary. Our brilliant youth go outside the country to do research and settle there. Until we check this trend, India can't make real progress in any field. Hence, an attempt is made to establish the Poornaprajna Institute of Scientific Research (PPISR) under the guidance of many eminent scientists of this country. More the investment by the nation in science and technology, stronger the country will evolve. All well wishers of this country are approached hereby for all possible assistance to this project, so that India may better serve the world. I pray for divine guidance. May the Lord grant the necessary strength to develop this institute for the benefit of the nation and the world.

H H Sri Vibudhesha Theertha Swamiji,
Founder, PPISR

Chairman's Message



The ancient Indian seers were indeed pioneering scientists, who investigated the spiritual laws underlying this wonderful physical world we live in. Inspired by this idea of a spiritual basis for scientific investigation due to these ancient scholar-saints, my beloved Guruji and illustrious predecessor, HH Sri Vibudhesha Theertha Swamiji, conceived of and constructed Poornaprajna Institute of Scientific Research (PPISR), to serve as the crest jewel from among the Poornaprajna family of schools and institutes founded by him. He envisioned for fundamental scientific research to be undertaken here in the same free spirit of curiosity, and for applied research to be pursued with the similar intent of contributing to the welfare of the world, that had marked the investigations of those ancient Upanishadic *rishis.*

Under the diligent stewardship of the present administration, headed ably by the Director Prof. A. B. Halgeri and the Secretary Prof K. Srihari, PPISR has witnessed in the past six years considerable growth in terms of producing our first batch of PhD students, who are now well placed in postdoctoral positions, improved research output in general terms, both qualitatively and quantitatively, and also in terms of infrastructure and laboratory development, assuring me that our institute is very well poised to fulfill Swamiji's vision for it, and emerge as a center of excellence in research, benefitting both Indian science and students in their service of the world community.

Through my numerous interactions with the scientists, staff and students at PPISR, I have sensed that we have progressed steadily from our the status of a nascent institute to one where we have established definite directions in terms of academic goals, as witnessed by the many invited talks and publications of our faculty members and their students. The increased demand for entry into our institute necessitated increasing our hostel facility, which has been accomplished thanks to the generous support of our Trustee members.

By the Grace of Lord Sri Krishna, may PPISR fulfill its destiny where scientists are empowered to pursue both pure and applied sciences for the benefit of the country and the world!

H H Sri Vishwapriya Theertha Swamiji
Chairman, AMEF

Contents

Message from Hon. Secretary, AMEC / AMEF

As the Pontiff of Sri Admar Mutt, Udupi, His Holiness Sri Vibudhesha Theertha Swamiji, fulfilling his religious duties, simultaneously maintained, unusual for the head of a spiritual organization, a keen interest in promoting science, in interacting with scientists and sometimes even attending classes and lectures. He was keen on bridging the two systems of scientific and spiritual knowledge. Even though he founded about 30 Poornaprajna Institutions or schools all over the Country, Poornaprajna Institute of Scientific Research established in Bidalur, Bengaluru during 1998 was considered as a crest jewel among them, as the tangible symbol of love of a Saint for the Science. He envisioned PPISR as a forum for Scientists to pursue uninterrupted research and to provide training to young researchers.

When H.H. Sri Vibudhesha Theertha Swamiji attained the Lotus Feet of Lord Sri Krishna, H.H. Sri Vishwapriya Theertha Swamiji, the present Pontiff of Sri Admar Mutt, Udupi, the President of AMEC and Chairman of AMEF, took up the task of guiding us through this journey that is simultaneously sacred and scientific. With the completion of the construction of the Bharat Ratna Prof C. N. R. Rao Laboratory for Materials Science and the successful completion of the doctoral work of the First Batch of our students, the first concrete step along the path laid by H.H. Sri Vibudhesha Theertha Swamiji has been achieved. With generous support from our Trust members and voluntary donors, a new hostel facility to accommodate 20 more students has been completed, which would enable us to meet the increased demand of research students.

This current year witnessed many milestones, which include PPISR crossing the 160 publications in peer-reviewed journals of international repute, an achievement that is especially significant considering that it was achieved in a shorter time and with fewer faculty members when compared to many other better known institutes. In PPISR's journey in pursuit of the noble vision set forth by H.H. Sri Vibudhesha Theertha Swamiji and guided by H.H. Sri Vishwapriya Theertha Swamiji, all activities of PPISR are being funded mainly by AMEF. It is our fond hope that more members from the Corporate World and the General Public would come forward to contribute their mite to furthering this noble cause of research in the fundamental and applied sciences.

Bengaluru
14th March, 2016

Dr. K. Srihari
Professor (Rtd), UAS, Bengaluru
Hon. Secretary, AMEC and AMEF

Foreword from the Director

I have a great pleasure in presenting the sixth Annual Report on account of research and academic activities of Poornaprajna Institute of Scientific Research (PPISR) for the year 2015-16. It has now become an academy of innovative science and applied research. We have been able to consolidate many of our academic activities in terms of completion of course work for PhD students who got registered with Manipal University.

PPISR is climbing the ladder of success steadily in a highly competitive scientific research and is coming into limelight on the national and international stage by maintaining the uniqueness in the research field. The Institute has chosen contemporary frontier areas of research in the fields of materials science and catalysis, biological science and theoretical Sciences. PPISR is successfully forging ahead a fruitful academia-industry partnership by innovating, designing and developing novel multifunctional materials that have wide-ranging applications in catalysis, nanotechnology etc. During this one year period, the Institute has published 30 research papers in all areas of sciences. Overall, PPISR has crossed 160 publications in international peer reviewed journals which in itself is a great achievement.

Several new areas of research have been initiated through the government agencies sponsored project like DBT, DST, VGST, BRNS & DRDO etc.

Based on the earlier successful completion of the industry projects by the Catalysis Group of PPISR, HPCL R&D has sponsored two more projects for the development of novel polymeric materials as well as development of novel catalysts for light naphtha valorization. M/S GTC Technology USA has sponsored a new project on catalyst and process development for natural gas conversion into value added chemicals.

The science outreach programmes with an aim of *Today's Science for Tomorrow's scientist* have been successfully conducted with our Poornaprajna School students in Bengaluru in order to create interest in basic science in young minds. We have provided opportunities for young talented students to carry out research projects. Four MTech students from Manipal Institute of Technology, Manipal have carried out one year project work under the guidance of the faculty members in Materials Science Department have successfully submitted their thesis for obtaining their MTech degrees.We have taken several collaborations with reputed institutions from both India and abroad. Based on our ongoing research projects, many of our students and faculty members have presented research papers at various National and International Conferences and have won best presentation awards. Several distinguished Professors and scientists from both India and abroad visited our Institute and have given lectures.

The infrastructure is being constantly upgraded to meet the academic requirement for carrying out scientific activities and this year H H Sri Vishwapriya Theertha Swamiji had laid foundation stone for the construction of a Bharat Ratna Prof. CNR Rao Laboratory ofMaterials Science at the Bidalur campus and this new laboratory will be inaugurated during the Founder's Day Celebrations in July 2016.

On the whole, the entire year 2015-16 was much more productive and successful with the unstinted support and blessings from H H Sri Vishwapriya Theertha Swamiji and also enthusiastic support from the management of Admar Mutt Education Foundation and Trustee members, and also with the support of all faculty members, students, and staff of PPISR.

Dr. A.B. Halgeri
Director

Board of Trustees

H. H. Sri Vishwapriya Theertha Swamiji (Chairman) Head of Admar Mutt

Special Advisors

- Padma Vibhushan Prof. P. Rama Rao FASc, FNA, FNASc, Ex. Secretary, Ministry of S & T, GOI.
- Sri K. R. Prasad, Advocate, Bengaluru.

Members

- Padma Bhushan Prof. U.R. Rao, Former Chairman, Space Commission & Secretary, Dept. of Space.
- Sri Rajendra J. Hinduja, Industrialist, Bengaluru.
- Sri V. V. Bhat, IAS, (Retd), Former Secretary to the Govt. of India.
- Prof. K.J. Rao FASc, FNA, FNASc, Professor, SSCU, IISc, Bengaluru.
- Sri B.R. Prabhakara, IAS, Former Chief Secretary Govt. of Karnataka.
- Sri Laxmisha G. Acharya, Industrialist, Mumbai.
- Dr. U. Shankar Rao, Medical Director, National Hospital, Chennai.
- Dr. Gautham Nadig, Director, Metahelix Life Sciences Pvt Ltd,Bengaluru.
- Padma Shri Dr. V.R. Prahalada, Former Vice Chancellor, Defence Institute of Advanced Technology, Pune.
- Dr. K. Srihari (Hon. Secretary), Professor (Rtd), UAS, Bengaluru.

Research Advisory Committee

Chairman

Padma Shri Dr. V. R. Prahalada, Former Vice Chancellor, Defense Institute of Advanced Technology, Pune

Members

- Prof. C. Sivaram, Professor, Indian Institute of Astrophysics, Bengaluru
- Prof. K.R. Krishnamurthy, Chair Professor,National Centre for Catalysis Research, IIT Madras, Chennai
- Prof. G. U. Kulkarni, Professor, JNCASR, Bengaluru
- Padma Shri Prof. N. Kumar, Emeritus Professor,Raman Research Institute, Bengaluru
- Prof. A Jagannadha Rao, Professor,Rajaramanna Fellow; DST, Department of Biochemistry, IISc, Bengaluru
- Prof. T.N. Guru Row, Professor,SSCU, IISc, Bengaluru
- Prof. S. Ramakumar, Professor, Bio Informatics Centre, IISc, Bengaluru
- Prof. T. M. Aminabhavi, CSIR Emeritus Scientist, Visiting Professor, Cambridge University, U.K
- Prof. A. B. Halgeri, (Member Secretary)
  Director, PPISR

Doctoral Advisory Committee

According to the UGC rules students registering under Manipal University for PhD degrees should have a doctoral advisory committee (DAC).The functions of the doctoral advisory committee are to review research progress of the doctoral student and also giving suggestions in further improving the quality of the research. Listed below are the members of DAC at PPISR for all the registered students in respective subjects who review every six month's progress.

1. Prof. Y. S. Bhat, HoD, Chemistry Dept, Bangalore Institute of Technology (BIT) Bengaluru.
2. Prof. B. S. Chandrasekhar, HoD, Chemistry Dept. Central University, Gulbarga.
3. Prof. T. N. Guru Row, SSCU, IISc, Bengaluru.
4. Prof. B. S. Jai Prakash, Director, IEHMM, BIT campus, Bengaluru.
5. Prof. N. Kumar, HomiBhabha Distinguished Professor, RRI, Bengaluru.
6. Prof. H. G. Nagendra, MVIT Engg. College, Bengaluru.
7. Prof. S. Ramakumar, Physics Dept., IISc, Bengaluru.
8. Dr. Raman Ravishankar, HPCL, Bengaluru.
9. Prof. A. J. Rao, Biochemistry Dept., IISc, Bengaluru.
10. Dr. N. S. Raviraja, Stempeutics Pvt. Ltd., Manipal.
11. Prof. S. A. Shivashankar, Materials Research Center (MRC), IISc, Bengaluru.
12. Prof. C. Sivaram, IIA, Bangalore University, Bengaluru.
13. Prof. A. M. Umarji, SSCU, IISc, Bengaluru.
14. Prof. A. R. Ushadevi, Bangalore University, Bengaluru.
15. Prof. Udupi Ramagopal, PPISR, Bengaluru.
16. Prof. N. Nagaraju, St. Joseph College, Bengaluru
17. Dr. Sabestian C. Peter, JNCASR, Bengaluru
18. Dr. Shanti K.N., PES University, Bengaluru

Organization

Director:	Dr. Anand B. Halgeri
Financial Advisor:	Sri P.Sreenivasa Rao
Faculty:	Dr. Udupi Ramagopal
	Dr. Sujit Sarkar
	Dr. Srikanth R
	Dr. Ananda K
	Dr. Ganapati V Shanbhag
	Dr. Nalini G Sundaram
	Dr. Sanjeev P Maradur
	Dr. Suresh Babu

Administration:

Senior Administrative Officer	Mr. Kishore L Gaikwad
Accounts Officer	Mr. Nagarajan R
Administrative Secretary	Mrs. Latha Srinivasan

Support staff:	Mr. Vishwaprakash A
	Mr. Praveen Kadam
	Mr. Shashidara
	Mr. Basavaraj

Adjunct/ Honorary Faculty

Prof. K J Rao, IISc, Bengaluru (Glasses & Ceramics)

Prof. S Asokan, IISc, Bengaluru (Glasses & Sensors)

Prof. T N Guru Row, IISc, Bengaluru (Crystallography)

Prof. S A Shivashankar, IISc, Bengaluru (Thin films)

Prof. K G Satyanarayana, Ex.Director, RRL (Polymers)

Prof. T M Aminabhavi, CSIR Emts Scientist, Dharwad (Polymers)

Prof. B S Jaiprakash, BIT/IEHMM, Bengaluru (Catalysis)

Prof. Y S Bhat, BIT, Bengaluru (Catalysis)

Prof. B S Ramchandra, CFRCE, Bengaluru (General relativity)

Prof. S K Srivatsa, PES University, Bengaluru (Liquid Crystals)

Prof. Suryaprakash, IISc, Bengaluru (NMR Studies)

About the Institute

PPISR was conceptualizedand founded by late HH Sri Vibudhesha Theertha Swamiji, the then chief pontiff of the Udupi Sri Admar Mutt to create a serene environment, conducive to scientists to ponder basic scientific questions, in much the manner that India's ancient philosopher-scientists did. The vision of Swamiji for PPISR is interpreted to be: *"To promote and nurture excellence in fundamental and applied sciences for the advancement of scientific knowledge and benefit of mankind".*

The institute is situated at Bidalur, near the Bengaluru International Airport on a sprawling area of 32 acres and is funded by Udupi Admar Mutt Education Foundation (AMEF). The foundation is a trust sponsored by the Admar Mutt Education Council (AMEC) and registered under the Karnataka Trust Act.

The AMEC is presently managing 30 Poornaprajna Education Institutions which have earned a name for themselves in providing quality education at school and college levels. A board of trustees consisting of eminent personalities was constituted to oversee the growth of PPISR. The present chairman, HH Sri Vishwapriya Theertha Swamiji has taken up the responsibility of fulfilling his Gurus dreams.

The foundation stone for the research campus was laid in 1998 by the then Prime minister of India, Sri A. B. Vajpayee. The first phase of buildings which provided office and laboratory space, also consisted of an auditorium with a capacity to seat 35 people and a modern kitchen. The building was inaugurated in May 2003 by the then deputy Prime Minister Sri L. K. Advani. The first phase of hiring of post-docs andfaculty started in 2003. Initially facultyin Theoretical Sciences were hired.

Since March 2010, Dr. Anand B. Halgeri, an eminent scientist from Reliance Petrochemicals, one of India's top industries, took charge as Director of PPISR and achieved appraisable growth. The research campus located at Bidalur, Devanahalli attained fully functional research labs with the procurement of advanced research equipments during last three years. A Laboratory dedicated to synthesis of materials for the Materials Science has been built and inaugurated in the first year. Recently biological science facility laboratory is built for the future research and inaugurated by Sri Vishwapriya Theertha Swamiji.

There are three departments, (A) Theoretical Sciences, (B) Materials Science, and (C) Biological Sciences under PPISR where research programmes of advanced nature are in progress. There are nine core faculty members working in materials science, biological sciences and in theoretical sciences in different research filed. All the faculty members are trained in advanced research laboratories abroad to conduct basic as well as applied research. The research laboratories are well equipped with state of the art instruments to give every advantage to the students and faculty pursuing research here. In addition to research, PPISR is also conducting outreach activities for high school students with the aim of " ***Today's Science for Tomorrow's Scientists***" in order to develop innovative and imaginative platform for research in young minds.

There are distinguished professors from other renowned institutions such as IISc, RRI, BIT, Bangalore University etc, graciously helping PPISR as adjunct and honorary professors. A research advisory committee formed to review and guide the overall progress of the research undertaken by different faculty at PPISR.

The mission of PPISR is to carry out world-class quality research in both basic and applied science involving multidisciplinary collaborations nationally and internationally and thus help graduate students reach their full potential by providing research guidance and technical skills required to live and work in a complex technological society. PPISR also conducts course works in core areas of Physics, Chemistry and Biology in order to strengthen the basic foundations of science in doctoral students.

The institute is recognized by DSIR, Govt. of India, New Delhi. PPISR is also recognized as a research centre byManipal University (MU), Manipal, Karnataka. Further all the faculty members arerecognized PhD supervisors of MU, Manipal and so far 9 students have obtained their PhD degree from Manipal University. Currently, 15 students are persuing their research for PhD degree. More than 160 research articles are published in reputed national/ international journals. In addition to this, 14 sponsored research projects carried out during 2015-16.

Contact details:

City office: Poornaprajna Institute of Scientific Research
City office No 4,16th Cross, Sadashivnagar, Bengaluru- 560 080
Karnataka, India. Phone: 080-236 11836

Main campus: Poornaprajna Institute of Scientific Research,Bidalur(post),
Devanahalli, Bengaluru -562 164 Karnataka, India. Telephone: 080-2760 7242, Website: http://ppisr.res.in

Sr. Administrative Officer: kishore@poornaprajna.org

Mission

- To carry out research in the selected frontier areas of basic and applied sciences
- To encourage and support sponsored research programmes by giving necessary infrastructure to them
- To encourage collaborations with industries for focused and application oriented research
- To promote collaborative research with scientists in academia in the country
- To produce PhDs of highest caliber and to make them highly competitive for their future career
- To provide a forum for scientific discussions on frontier scientific topics which are vital for the scientists of PPISR in particular and the institutes of the country in general
- To organize periodic summer and winter schools for the young undergraduate and graduate students
- To provide opportunities for talented young students to carry out short-term research projects
- To provide facilities to visiting scholars and faculty from all over India and abroad to work with the faculty of the institute
- To publish research articles in reputed national/ international journals of high impact
- To file patents on research findings of potential commercial applications

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Key Accomplishments during 2015-2016

1) PhD award for nine students by Manipal University

The PhD programme in PPISR started in 2010 with the recognition of the institute by Manipal University as a research centre for conducting PhD course. At the same time, all the core faculty members who had a lot of experience in research in India & abroad with proven credentials got the recognition from Manipal University as PhD guides. The institute also set up the laboratories for Materials Science and Biological Sciences with the installation of advanced equipments like XRD, AAS, UV-Vis, FTIR, flow reactors etc. The institute inducted initially 9 MSc graduates for the PhD programmes in various frontier areas of research like heterogeneous catalysis, biomass conversion and biodiesel synthesis, pore engineered zeolite catalysts for aromatization and aromatic substitution reactions,functional nanomaterials for photocatalytic and photoluminescent applications, sealed-tube pyrolysis for nano-metal oxides, Polymeric composite membranes for Pervaporation, bioactive compounds from endophytic fungi of *Eucalyptus* and *Simarouba* plants, alpha amylase inhibitors and aldose reductase inhibitors from endophytic fungi of medicinal plants, in theoretical physics, quantum noise and quantum dynamics. All the 9 students excelled in their research and published research papers in high impact reputed international journals. They also presented their research work in national and international conferences and won best presentation awards. Ms. Swetha S M won the 'Rising Star Oral Presentation Award' for her research work at prestigious AsCA13 conference held in HKUST, Hong Kong.Mrs. Swetha Sandesh won "Best Oral presentation award" at a National symposium in Kuvempu University on "Social Relevance of Chemical Sciences" in March 2011.Mr. Vijaykumar received best poster presentationaward for "Tin(II)hydroxychloride: A Novel Solid Brønsted Acid Catalyst for Selected Condensation Reactions"in the National Workshop on Catalysis, CSIR-NEERI, Nagpur, Maharashtra on February 2014 sponsored by Catalysis Society of India. Similarly, Janardhan H L, Suhas D P and Pavithra N also won best presentation awards in National Conferences.
All the 9 students received the PhD award in 2015 from Manipal University. They also received certificates of recognition from Bharat Ratna Prof. C. N. R. Rao during Founder's Day Programme on June 24, 2015.

2) Successful completion of 4-year GTC USA sponsored project

Research collaboration of GTC Technology Inc, USA with PPISR started in 2010 with the project involved "Design and development of the catalyst and process for selective toluene methylation to xylenes". Among xylenes, para xylene was a target product which is used mainly as raw material for the synthesis of polymers including PET and PTA. As a time targeted project, the Catalysis Group of PPISR with the able guidance of Dr. A. B. Halgeri as Project Coordinator and Dr. Ganapati V. Shanbhag as Principal Investigator started in 2010 with the creation of research facilities for catalysis research and recruitment of project students. The first year of the project mainly involved exploratory research on finding new catalyst and process

conditions. The hard work of the Catalysis group was paid off with a development of novel catalyst with a long life without decrease in activity till 600 time on stream as demonstrated by PPISR in a highly accurate fully automated Catalyst Testing Unit. The process was also free from expensive hydrogen but instead, steam was used as a carrier. With the success of grueling one year project, PPISR was able to gain the confidence of GTC which made them to extend the project. The second year project focused mainly on developing 1st generation catalyst targeting high conversion, high methanol utilization towards xylenes and long catalyst life. This also focused on scale up studies and industrial requirements of mechanical properties of the catalysts. Dr. Shanbhag visited China to study scale up preparation of the catalyst. During second year, the project was strengthened by the joining of Dr. Sanjeev Maradur as a Co-investigator in the project. Also, advanced catalyst preparation and testing facilities like imported kg level controlled kneader, electric extruder, crush strength machine and attrition resistance tester were established. 1st Generation toluene methylation catalyst was successfully developed during 2012-2013 project. This made GTC to extend the project for another 2 years where the focus was mainly on developing 2nd generation catalyst aimed at developing novel catalyst that gives high para xylene selectivity. It was challenging to design a catalyst which is novel and at the same time highly active, selective, stable and reusable. With a considerable effort from Catalysis group of PPISR and with the help of Team GTC, 2nd generation catalyst was successfully developed. Key accomplishments are as follows.

- ✓ GTC announced Tolalk Technology worldwide on selective toluene methylation in 2014
- ✓ GTC licennced Tolkalk Technology to a refinery in China in 2015
- ✓ PPISR received plaques from GTC in 2012, 2014, 2015 in appreciation of in developing 1st and 2nd generation TM catalysts which are ready for commercial exploitation.
- ✓ A patent was filed by GTC based on the work conducted at PPISR

Overall, the collaborative project from GTC Technology Inc, USA has been highly successful and GTC continued the collaboration with a new project on catalytic Gas to liquid (GTL) process through its subsidiary company Pinti Wang Technology, USA.

3) Recognition of PPISR at national and international stage

PPISR is climbing the ladder of success steadily in a highly competitive scientific research and is coming into limelight on the national and international stage by maintaining the uniqueness in the research field. The institute has chosen contemporary frontier areas of research in the fields of materials science and catalysis, biological sciences and theoretical sciences. Some of the important recognitions are as follows.

a) Sponsored Projects:

Research projects were sponsored by companies from India and abroad like GTC Technology Inc USA, PW Technology Inc, USA, Clarient Germany, Hindustan Petroleum Corporation Ltd (HPCL), Shell R & D Centre, India, Thermax Industries Pune. All the projects are completed successfully.

GTC Technology Inc, USA identified PPISR as their preferred laboratory in India to work for collaborative project and renewed the project every year since 2010 based on the outcome of the projects. The company also appreciated the research work carried out by PPISR by giving plaques for achieving important milestones.

HPCL R & D Centre also continued their support by giving 2 new projects in this financial year.

Govt of India recognized PPISR as a research centre for conducting advanced scientific research and awarded several sponsored projects through its different agencies like DST, DBT, BRNS and UGC-DAE. In addition to this, Govt of Karnataka also awarded 5 sponsored projects under the grants Centre of Excellence in Science Engineering & Medicine, CESEE, Seed money for young Scientists and TRIP. The completed projects were successful with publications in reputed international journals with timely submission of reports.

In this financial year, overall 14 sponsored projects were executed at PPISR with the funding from nine sponsored agencies.

b) National and international collaborations:

The institute has MOU with many institutes for collaborative research likeArgonne National Laboratory, Chicago, IIT-Madras, Chennai, Central University, Gulbarga, SIT, Tumkur and MSRIT, Bengaluru.

The research groups of PPISR have academic research collaborations with many national institutes like IISc, Bengaluru, RRI, Bengaluru, NIT Suratkal, MIT Manipal, IIT Ropar, IIT Rajastan, Bose Institute, Kolkota, JIIT, Noida, VBU, Hazaribag, NCL Pune.

The faculty of PPISR also have international collaborations with reputed institute like Albert Einstein College of Medicine, New York, USA and Karlshure Institute of Technology, Germany, University of Moncton, Canada and ORNL, USA.

c) Publications:

The institute has published more than 160 papers in peer reviewed reputed international journals so far with an average impact factor 2.5. For the year 2015-2016, overall 30 research articles were published in journals with avg impact factor of 2.9. Among them, Catalysis Science & Technology (IF 5.4), Crystal Growth & Design (IF = 4.9), PCCP (IF = 4.5), Applied Catalysis A (IF: 3.9), RSC Advances (IF 3.8), Physics Review A (IF = 2.8) are important to note.

d) Best paper presentation awards:

The research scholars won several best presentation awards at national/ international conferences during last 5 years from all the three departments and scientific community appreciated the research carried out at PPISR. Some examples are, AsCA13 conference held in HKUST, Hong Kong, National Workshop on Catalysis, CSIR-NEERI, Nagpur, Maharashtra, National conference at Kuvmpu University, Shimoga, National conference at MIT, Manipal, Madras University, Chennai and 13th Asian Crystallographic Association conference, Kolkata.

Alumni of PPISR

1. Dr (Mrs). Swetha Sandesh

PhD topic: Novel eco-friendly catalysts for biodiesel synthesis and conversion of byproduct glycerol into value-added products

PhD from: Manipal University
Guide: Dr. A. B. Halgeri
Co-guide: Dr. Ganapati Shanbhag
Date of Registration for PhD: 10th December 2011
Date of Award: 09th May 2015
Number of Publications: 05
Present Position: CEO, Niranthara Scientific Solutions Pvt Ltd

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2. Dr. Vijaykumar Marakatti

PhD topic: Design of solid acid catalysts for Prins reaction and toluene methylation

PhD from: Manipal University
Guide: Dr. Ganapati Shanbhag
Co-guide: Dr. A. B. Halgeri
Date of Registration for PhD: 10th December 2011
Date of Award: 28th April 2015
Number of Publications: 08
Number of Patents: 01 (filed)
Present Position: Research Associate, JNCSAR, Bengaluru

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3. Dr. Janardhan H L

PhD topic: Studies on pore modified zeolite catalysts for aromatization and aromatic substitution reactions

PhD from: Manipal University
Guide: Dr. Ganapati Shanbhag
Co-guide: Dr. A. B. Halgeri
Date of Registration for PhD: 10th December 2011
Date of Award: 10th June 2015
Number of Publications: 05
Number of Patents: 01 (filed)
Present Position: Post Doctoral Fellow, KIST, Seoul, South Korea

4. Dr. Swetha S.M

PhD topic: Investigation of smart oxide nanomaterials for photoluminescent and photocatalytic applications

PhD from: Manipal University
Guide: Dr. Nalini Sundaram
Date of Registration for PhD: 4th November 2011
Date of Award: 05th June 2015
Number of Publications: 05
Present Position: Reasearch Associate, IISER, Trivandrum

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5. Dr. Srinidhi Raghavan

PhD topic: Carbonaceous, Nanostructured Metal Oxides Obtained From Metalorganic Precursors through Inert-Ambient, Sealed-Tube Pyrolysis

PhD from: Manipal University
Guide: Dr. Nalini Sundaram
Date of Registration for PhD: 4th November 2011
Date of Award: 30th March 2015
Number of Publications: 03
Present Position: Research Associate, IISc, Bengaluru

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6. Dr. Suhas D. P.

PhD topic: Polymeric Composite Membranes for Pervaporation Separation of Alcohol-Water Binary Mixtures

PhD from: Manipal University
Guide: Dr. A. V. Raghu
Date of Registration for PhD: 25th November 2011
Date of Award: 15th April 2015
Number of Publications: 06
Present Position: Asst. Professor, St. Joseph College, Bengaluru

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7. Dr. Omkar Srikrishna

PhD on the topic: Quantum Noise due to Dissipative and Non-dissipative Interaction with a Squeezed Environment, Quantum Error Correcting Codes and Characterizing Quantum Dynamics.

PhD from: Manipal University
Guide: Dr. Srikanth R.
Date of Registration for PhD: 4th November 2011
Date of Award: 11th July 2015
Number of Publications: 05
Present Position: Postdoc, IISER, Trivandrum

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8. Dr. Satish L.

PhD on the topic: Studies on bioactive compounds from endophytic fungi of *Eucalyptus* and *Simarouba* plants.

PhD from: Manipal University
Guide: Dr. Ananda K.
Date of Registration for PhD: 16th November 2011
Date of Award: 14thMay 2015
Number of Publications: 04
Present Position: Scientist- B, Central Silk Board Mysore

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9. Dr. Pavithra N.

PhD on the topic: Screening and characterization of alpha amylase inhibitors and aldose reductase inhibitors from endophytic fungi of medicinal plants

PhD from: Manipal University
Guide: Dr. Ananda K.
Date of Registration for PhD: 16th November 2011
Date of Award: 12th June 2015
Number of Publications: 04
Present Position: Postdoc in St. Johns Medical College, Bengaluru

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Department Structure

Faculty	Students
Materials Science	
Dr. A. B. Halgeri (Catalysis), Director	
Dr. Ganapati V. Shanbhag (Catalysis)	Dr.Prakash Chandra (Research Associate)
Asst. Professor	Mr. Manjunathan P (Research Scholar) Mr. Santosh Kumar (Research Engineer) Mr. Saikiran (Research Engineer) Mr. Darshan Gaonkar (Research Scholar) Mr. Nagendra Kulal (Research Scholar) Mr. Manjunath Doddamani (Research Fellow) Mr. Mahesh Kumar (Research Fellow) Mr. Girish Kamath (MTech project fellow)
Dr. Nalini G. Sundaram (Nanomaterials) Asst. Professor	Dr. Sowmya Palimar (Research Associate) Mr. Pradeep Shanbogh (Research Scholar) Ms Archana (Research Scholar) Mr. Bharath (MTech project fellow)
Dr. Sanjeev P. Maradur (Catalysis) Asst. Professor	Mr. Sathyapal (Research Scholar) Mr. Kempanna S. K. (Project Assistant) Mr. Manish Kumar (MTech Project Fellow) Mr. Sharath Ravi (MTech Project Fellow)
Dr. Suresh Babu Kalidindi (Materials Design) DST-INSPIRE faculty/Assistant professor	Mr. Vasudev Rao (Research Scholar) Ms. Sucharita Kamath (MTech Project Fellow)
Biological Sciences	
Dr. U A Ramagopal (Structural Biology) Associate Professor Ramalingaswami Fellow	Dr. Raghurama Hegde (Research Associate) Ms. Pavithra G C (Research Scholar) Ms. Swetha L (Research Scholar) Mr. Shankar Kundapur
Dr. K Ananda (Mycology) Asst. Professor	Ms. Kavita (Research Scholar) Mr. Kiran M. P. (Research Scholar) Ms. Shrilakshmi S. (Research Scholar)
Theoretical Sciences	
Dr. Sujit Sarkar (Quantum Physics) Asst. Professor	Mr. Nepal Banerjee (Research Scholar)
Dr. Srikanth R (Quantum Information) Asst. Professor	Mr. Aravinda S. (Research Scholar)

Materials Science Department

Established in May 2010 by the present Director, Dr. A. B. Halgeri, with the assistance of Prof. K. J. Rao, then Chair, Executive Committee of AMEF, the department now consists of a core of five faculty members hailing from diverse backgrounds. A new materials synthesis laboratory, with several sophisticated equipment, has been established in the group in 2010. Bright students with passion for research were interviewed and inducted into Doctoral Programme in the Department. So far 6 research scholars have obtained PhD degree from this institute and 32 research articles were published in reputed international journals so far from Materials Science department in the last 5 years. Several industry and Govt. sponsored projects were successfully completed and during 2015-16, nine sponsored projects were executed by 3 research groups of this department.

Mission of the department:

1. To forge a fruitful academia-industry partnership by innovating, designing and developing novel multifunctional materials that have wide-ranging applications, in catalysis, nanotechnology, new materials design etc.
2. To develop a strong doctoral programme to train students by fostering excellence and original thinking.

The department engages with other national academic institutions through collaborations, education training and outreach activities.

The broad areas of the researchinclude: (1) Novel functional materials; (2) Novel micro/mesoporous materials for green chemical processes; (3) Biomass conversion to value added products; (4) X-ray crystallographic studies; (5) Functional nanomaterials, (6) Photocatalytic and photoluminescent materials (7) Polymers, (8) Metal organic frameworks

Academic and sponsored research Highlights

Catalysis group:

Catalysis is one of the important fields of research in the area of applied chemistry. Catalysts play a vital role in providing society fuels, commodity and fine chemicals, pharmaceuticals, polymers and means for protecting the environment. At PPISR, three research groups are working in the area of heterogeneous catalysis. Dr. Ganapati Shanbhag and his group are working on frontier areas of research such as design of novel catalysts for green chemical processes such as catalytic conversion of CO_2 into value-added chemicals, conversion of biomass byproducts like glycerol and furfural to value-added chemicals, pore engineering of microporous materials for shape selective catalysis etc. The novel bifunctional solid catalyst, bimetal composite oxide was designed and applied for cycloaddition of carbon dioxide to epoxides to form cyclic carbonates which has number of applications in excellent aprotic polar solvents, electrolytes in secondary batteries, precursors for polycarbonates and other polymeric materials, and intermediates for fine chemicals like dialkyl carbonates, glycols, carbamates, pyrimidines, purines, etc. The work on mesoporous tin phosphate as the novel solid acid catalyst for alcoholysis of furural alcohol with butanol to make butyl levulinate is under progress. Fufural alcohol is obtained from reduction of furfural, a biorefinery byproduct. The work on synthesizing novel mesoporous materials is also going on. During this year, the group has published 8 research articles in internationally reputed journals.

In this finantial year,6 sponsored projects are conducted by the Catalysis Group. A new project on “Design and development of a catalyst and process for the conversion of C1-C3 paraffins to value added hydrocarbons” sponsored by PW Technology Inc, USA was initiated in January 2016 by Dr. Ganapati Shanbhag as PI and Dr. Sanjeev Maradur as Co-PI. The previous industrial project sponsored by GTC Technology Inc USA successfully completed in November 2015 with the toluene methylation technology in the process of commercialization. A project sponsored by HPCL R & D Centre, Bengaluru on “Catalytic valorization of hydrocarbons to value-added chemicals’ is currently underway with Dr. Shanbhag as the PI and Dr. Maradur as Co-PI. The 3rd project is on “Chemical fixation of CO_2 by converting into useful chemicals using modified nanoporous catalysts” sponsored by VGST, Govt. of Karnataka has successfully completed one year with a research publication in ChemCatChem (Wiley) journal. Dr. Sanjeev Maradur and his group are working on novel mesoporous polymers, supported metal oxides, mesoporous zeolites for catalytic applications. His project on conversion of waste plastic to fuels sponsored by Thermax industries, Pune is successfully completed. A new project sponsored by HP Green R & D Centre on design and development of polymeric materials for catalytic applications was initiated in February 2016 with Dr. Sanjeev Maradur as PI and Dr. Shanbhag as Co-PI.

Functional Energy Nanomaterials Group:

The group works extensively in key energy areas such as photocatalysis, Photoluminescence, Gas sensing and Ferroelectrics. In the last half-year, the gas

sensingstudy station sponsored by DST setup at PPISR has been optimized by measuring the sensing behaviour SnO_2 a standard against 10ppm CO in various temperatures and flow rates. Presently, the sensing behavior of $La_{0.8}Ca_{0.2}FeO_3$ pellets has been directly monitored by Source meter at different temperatures. One manuscript based on this work is under revision. The results are promising and presently the gas sensing behaviour of films prepared by spin coating are under way. In the area of photocatalysis, promising results have been obtained for nanocomposite as well as Bi based heterostructures.

The proposal submitted to utilize the HRTEM for understanding the heterostructures, under the Central Europium Consortium was accepted and funded. Two members of the group travelled to the National Institute of Materials Physics, Romania for measurements. Discussions about the results are in progress. The work pertaining to the Fluorescent imaging of cells using photoluminescent nanoparticles has been initiated and is progressing in leaps and bounds. The possible applications of rare earth based nanoparticles have not been fully explored especially in the field of biomedical sciences. Preliminary experiments to check bacterial cytotoxicity of these nanoparticles tests prove that they are biocompatible and also fluorescence inside the bacteria.

One student has successfully presented her synopsis titled “Design of Oxide Nanomaterials for Photoluminescent and Gas Sensing Applications” and registered at Manipal University in July 2015. One M.Tech Student is working on a one year project titled “Multifunctional Composite Oxides for Photocatalytic and Gas Sensor application”. Irradiating of the tungstate nanoparticle samples at the electron beam facility at RRCAT, Indore has been carried out. A new venture by the group is the collaborative project taken up with Dr. Pandurang Ashrith of University of Moncton, Canada. During this year, 4 research articles have been published in reputed international journals.

Material design group:

Dr. Suresh Babu and his co-workers are involved in the designing of metal organic frameworks (MOFs) and boron nanomaterials for catalytic applications. A new DST-sponsored project titled “Design and development of stable metal organic frameworks with multifunctional sites for catalysis” has been initiated. The project aims at harnessing the superior tunability of MOFs to co-assemble different catalyticunits (more than two) in a well-defined way for cooperative/tandem catalysis with the objective of forming high-value added products. One Ph.D student is working in this project. One M. Tech student has successfully submitted her thesis to Manipal university titled “Modification of palladium with boron for selective hydrogenation of α-β unsaturated aldehydes”. Her project involved successful incorporation boron into Pd nanoparticles which improved selectivity for hydrogenation of α-β unsaturated aldehydes. Dr. Suresh is also involved in teaching activities at PPISR and taught Analytical Methods & Instrumentation course for Ph. D students.

Faculty Profiles

Dr. A. B. Halgeri,

Director

abhalgeri@poornaprajna.org

EDUCATIONAL QUALIFICATIONS

1. Masters Degree in Chemistry from Karnataka University, Dharwar
2. PhD in Physical Chemistry (Heterogeneous Catalysis) from Bangalore University
3. Post-Doctoral researcher under UNESCO fellowship on Zeolite Catalysis at Department of Tokyo institute of Technology

AREAS OF INTEREST:

Dr. Anand B. Halgeri is currently working as Director of Poornaprajna Institute of Scientific Research and coordinating the entire research activity in Catalysis/ Materials science, Biological sciences and theoretical sciences. His area of interest includes Nano catalysis, Heterogeneous catalysis, mesoporous materials, novel Zeolites, Solid Acid/ Base Catalysts, Industrial Refinery/petrochemical processes, adsorption, Eco-friendly processes, and Biodiesel/Biofuel, alternate energy feed stocks etc. He has taken several industrial research projects both from India and abroad in the area of Zeolite Catalysis and Materials Science.

CURRENT ACHIEVEMENTS:

- Prof. Halgeri is actively involved in the industrial projects and, is responsible for getting sponsorships from the companies M/s GTC Technologies, USA, HPCL R & D, and Shell Technology India Pvt Ltd. The process technology for development of catalyst &process for the production of para-xylene which is raw material for polyester industry has been developed by our catalysis group in association with GTC and is likely to be commercialized in PetroChina.

Industrial projects successfully completed under his dynamic leadership are as follows:

- Design and development of a catalyst and process for selective methylation of benzene/ toluene to produce *p*-xylene *(Sponsored by: GTC Technology, USA).*
- Post-synthesis pore engineering and surface treatment of zeolites and some oxide materials (*Sponsored by: Shell Technology Centre, Bangalore)*
- Development of Zeolite Modified Catalysts for the Hydrocarbon Conversions such as light naphtha aromatization and side chain alkylation of toluene *(Sponsored by: HP Green R & D Centre, Bangalore).*

Ongoing Industrial Projects:

1. **"**Development of a Novel Mesoporous Polymer Based Soild Acid Catalyst for LowTemperature Catalytic Applications" sponsored by HPCL (R&D)
2. "Development of Novel Catalyst for light naphtha valorisation" sponsored by HPCL (R&D)
3. "Natural gas conversion to value-added chemicals" sponsored by to M/S.GTC Technology US LLC.
4. "Catalytic conversion of Plastic to Fuels" sponsored by Thermax Industry, Pune.

Ongoing Government Agency sponsored project:

Nearly 10 projects sponsored by government agencies like DBT, DST, BRNS, DRDO, VGST are being carried out at PPISR.

Major Achievement at PPISR:

During his tenure as the Director, first batch of 9 research scholars have obtained their PhD degree at PPISR

PUBLICATIONS AND PATENTS

He has published 140 research papers in national and international peer reviewed journals and has also obtained 35 Indian and International patents.

PhDS GUIDED

Three doctorates under his guidance are

1. Mrs. Swetha Sandesh (Guide)
2. Mr. Vijaykumar M. (Co-guide)
3. Mr. Janardhan H. L (Co-guide).

PREVIOUS R & D ACCOMPLISHMENTS IN INDUSTRY:

Dr Halgeri, joined in a newly established Research Centre of the Indian Petrochemicals Corporation Ltd (IPCL), Baroda – Gujarat in 1976. As Vice President and Head of R&D Division of the Public Sector Indian Petrochemicals Corporation Ltd. Baroda, Gujarat, Dr. Halgeri provided sustained leadership to the large number of scientists engaged in research and Development activities. Later, Dr. Halgeri joined the Research and Development Centre of Reliance Industries Ltd, where he led a team of 150 Scientists and Engineers and coordinated the entire research and development activities on catalysts required for the Petrochemical units and Refineries. He also provided the research support for the Polymer Science and Technology, and Materials Science groups of all the units of Reliance Industries at different locations.

Before joining PPISR, Dr. Halgeri has worked extensively and achieved several milestones in the development and commercialization of catalysts for the petrochemical industry. Dr.Halgeri's contribution in the area of catalysts has helped putting India in the world map of petrochemicals. In recognition of his outstanding contribution, Dr. Halgeri has received several National awards and Honors for his achievements in Chemical Technology.

AWARDS & HONOURS

In recognition of his outstanding contribution in the area of heterogeneous catalysis for over three decades, he has received several National awards and Honors for his achievements in Chemical Technology.

1] ICI India Ltd Award of Indian Institute of Chemical Engineers has been conferred to him for Excellence in process/Product development for para-diethyl benzene.

2] Hari Om Ashram Prerit- Prof.S.S. Bhatnagar Endowment Research Award for Excellence in Applied Catalysis.

3] Lifetime Achievement Award "Eminent Scientist in Catalysis" by the Catalysis Society of India, Indian Institute of Technology, Madras.

4] Elected as "Fellow of Institute of Chemical Engineer" by Indian Institute of Chemical Engineers, Kolkatta.

5] Vividhalaxshi Audyogik Samshodhan Vikas Kendra, Mumbai, VASVIK Industrial National Award in Chemical Sciences and Technology - 2005.

6] Prof. K.G. Naik Memorial Gold Award of M.S. University, Baroda – 2007 for outstanding achievements in Chemical Sciences.

7] Awarded as "Pride citizen of Baroda" in recognition of significant contribution for Science & Technology from Community Science Centre/Rotary Club of Baroda - 2008.

He has extensively travelled and presented several lectures/papers in International and National conferences. Currently, he has been advisor for many Industrial R&D and also member of Board of studies in Chemical Engineering Departments in many Engineering Colleges.

Dr. Ganapati V. Shanbhag

Assistant Professor

E-mail:shanbhag@poornaprajna.org

BRIEF CV:

- 2010-Present: Asst. Professor, PPISR, Bengaluru, India
- 2008-2010: Research Scientist, Dept. of Chemistry, Korea Advanced Institute of Science and technology (KAIST), South Korea
- 2002-2008: Ph.D. CSIR-National Chemical Laboratory, Pune India
- 2000-2001: Research Associate, ICI India Ltd (MNC), Mumbai, India
- 1999-2000: Lecturer, M.M Arts and Science College, Sirsi, Karnataka, India
- 1999: M.Sc. Organic Chemistry, Karnatak University, Dharwad, India

RESEARCH INTERESTS:

1. Novel catalytic materials

There are many reactions for which existing catalysts have some drawbacks and could not give good efficiency for required products. Also, there are many reactions for which homogeneous catalysts are used till today and need to be replaced with heterogeneous catalysts. Catalysis research is never stagnant and requires constant efforts to find new catalysts better than existing ones. New materials always open up a lot of research to study their unknown properties.

2. Chemical fixation of CO_2 by converting into valuable chemicals.

Industrial and automobile effluent gas, CO_2 conversion to hydrocarbons over catalysts has been shown very little research and development attention so far, as other technologies has been much cheaper and efficient in yielding hydrocarbons. However, nowadays, with the increasing awareness of the impact CO_2 is having on the environment,a lot of attention is being directed at the methods to mitigate the effects CO_2 as a greenhouse gas.Electricity generation from coal flue gas from chemical industries and running automobiles contribute to a great extent in generating CO_2. Hence it is necessary to convert CO_2 from industrial flue gas into valuable chemicals instead of leaving it into atmosphere. However, CO_2 being an inert gas, its activation and conversion into valuable chemicals is a challenge and require a design of catalyst to make these processes feasible.

3. Catalyst design for biofuel synthesis

The research in the present decade is mainly dedicated to "energy" because of the concerns over diminishing fossil fuels like LPG, petrol and diesel. A lot of efforts are going on to make new biofuels from renewable sources such as non-edible vegetable oils, wet biomass and wood based biomass. Biodiesel synthesized from catalytic transesterification of vegetable oilwas already tested to be fit to use as a blend with diesel. Biomass processing with multiple steps like hydropyrolysis and gasificationyields mixture of hydrocarbons and oxygenated compounds which upon refining can yield biofuels with desired quality. However, easier said than done, it is a challenge to design catalysts to selectively produce the desired biofuels with high efficiency.

4. Pore engineering of microporous materials

Vapor phase alkylation and disproportionation of aromatics are important reactions practiced in petrochemical industries. For these reactions, thermodynamic equilibrium mixtures of all the regioisomers are obtained with nonselective catalyst. Selectivity towards para-isomer can only be increased by the application of shape-selective catalyst. The para-isomer being commercially important than the other two for many organic reactions, post synthesis modification is desirable to improve the product selectivity. Phosphate modification was studied extensively by our group to explore the generation of new active sites, correlation of shape selectivity with phosphate modification and several model reactions such as toluene alkylation, ethyl benzene ethylation and disproportionation and competitive reaction of meta xylene and ethyl benzene. Three of such works are published in Applied Catalysis A and Chemical Engineering Science journals.

ACHIEVEMENTS/RECOGNISTIONS/AWARDS/MEMBERSHIP:

- **Guided** 2 students for their PhD degree and 1 student as **co-guide**. Also guided 3 students for their MTech thesis as **external guide**.
- 16 research publications as corresponding author in internationally reputed journals and 1 book chapter in last 5 years. Overall 36 publications in his research career.
- **Co-inventor** in the 2 World **patent (PCT)** applications filed by HPCL R & D Centre, Bengaluru evolved as a result of a collaborative project.
- Received a **Meritorious Award** for Excellence in Research from AMEF during Founder's day July 6, 2012 in recognition of contribution towards research and development at PPISR.
- **Editorial board member** of the journal "**Journal of Catalyst and Catalysis.**"
- Member of the **Syllabus revision committee for Chemistry** for Siddaganga Institute of Technology (SIT), Tumkur.
- **Reviewer for international journals** *viz.* Chemical Communicaions (RSC), Applied Catalysis A (Elsevier), Catalysis Science and Technology (RSC), Catalysis Communications (Elsevier) and Journal of Chemical Sciences (Elsevier), Biomass

& Bioenergy (Elsevier), Springer Plus, Energy Technology (Wiley), ChemCatChem (Wiley).

- **Resource person** for Refresher Course Programme for PU college Lecturers sponsored by VGST, Govt of Karnataka.
- **Three best oral/poster presentation awards** to the group for the research papers presented at National symposiums/workshops, 1. Kuvempu University on "Social Relevance of Chemical Sciences" in March 2011 (student: Mrs. SwethaSandesh) 2. Manipal Institute of Technology , "National Symposium on Chemistry and Humanity" in Manipal, July, 2011 (Student: Mr. Janardhan H L) and 3. National Workshop on Catalysis, CSIR-NEERI, Nagpur, Maharashtra on 4-5, Feb 2014 (Student: Mr. VijaykumarMarakatti).
- Received '**plaques**' as a Principal Investigator of the sponsored project from **GTC Technology Inc. USA** in 2012, 2014 and 2015 in recognition of the milestones achieved by the group in developing a modified zeolite catalyst for aromatics technology.
- Life member of International Zeolite Association (IZA) and Catalysis Society of India (CSI)

RESEARCH GROUP

Research Associate

1. Dr. Prakash Chandra

PhD students

2. Manjunathan P
3. Nagendra Kulal
4. Darshan Gaonkar

Project Fellows

5. Santosh Kumar J.
6. Saikiran M.
7. Manjunath Doddamani
8. Mahesh Kumar T.
9. Girish Kamath

Past students

Doctoral students

1. Vijaykumar Marakatti (Present: Post Doc, JNCASR, Bengaluru)
2. Janardhan H L (Present: Post Doc, KIST, South Korea)
3. Swetha Sandesh (Present: CEO, Nirathara Scientific Solutions Pvt Ltd)

M.Tech. project students

1. Satish Burla (Present: Research Engineer, SABIC Technology Center, Bengaluru)
2. Prashant Kumar (Present: Research Engineer, SABIC Technology Center, Bengaluru)

NATIONAL AND INTERNATIONAL COLLABORATORS

1. Dr. Ding ZhongYi, Technology Manager, PWT Inc, USA
2. Dr. Raman Ravishankar, Chief Manager, HP Green R & D Center, Bengaluru
3. Prof. Y. S. Bhat, HoD, Chemistry Dept, Bangalore Institute of Technology, Bengaluru
4. Prof. Shubhangi Umbarkar, Sr. Scientist, CSIR-National Chemical Laboratory, Pune.
5. Prof. Rajendra Srivastava, Asst. Professor, IIT-Ropar, Punjab

RESEARCH

SPONSORED PROJECTS:

1. **Design and development of a catalyst and process for C1-C3 hydrocarbon conversion to olefins and aromatics**

   (Sponsored by: ***PW Technology, USA****)*

   Principal Investigator: Dr. Ganapati V Shanbhag

   Co-Investigator: Dr. Sanjeev P Maradur

   Project fellows: Mr. Santosh Kumar, Mr. Saikiran, Mr. Manjunath D., Mr. Mahesh Kumar

   Starting Date: January 2016

   A new agreement between PPISR and PW Technology, USA was signed in December 2015 for starting a new project on "Design and development of a catalyst and process for C_1-C_3 hydrocarbon conversion to olefins and aromatics" and the project was initiated from January 2016. The project was started with recruitment of project fellows and purchasing the required equipments. Walk-in fume hood and reactor modification for high pressure testing were completed. Initial results on the designed catalyst for the conversion of LPG into value added chemicals in a fixed bed quartz flow reactor gave good results. Further testing in high pressure microreactor is underway.

   Status: Ongoing

2. **Design and development of a catalyst and process for selective methylation of benzene/ toluene to produce *p*-xylene**

   (Sponsored by: ***GTC Technology, USA****)*

   Principal Investigator: Dr. Ganapati V Shanbhag

   Co-Investigator: Dr. Sanjeev P Maradur

   Research Fellows: Mr. Santosh Kumar, Mr. Saikiran and Mr. Kempanna

   Toluene/benzene alkylation with methanol was continued using modified zeolite catalyst as a part of development of 2nd generation catalyst for TM process. Two reactor in series was set up for toluene methylation to produce xylenes. The 1st generation catalyst was used in the series reactor. Time on stream experiments for 150 hours were conducted to study the performance under various conditions and catalyst life time. The toluene conversion was almost twice than the single reactor and catalyst life time increased with series reactor. Furthermore, benzene methylation was also tested in series reactor aimed to achieve high benzene conversion with long catalyst life. Around 150 hours' time on stream studies were conducted and the detailed confidential report was submitted to GTC.

Status: Completed

3. **Development of novel catalysts for light naphtha valorization**

*(Sponsored by**: Hindustan Petroleum Green Research and Development Centre (HPGRDC), Hindustan Petroleum Corporation Ltd. (HPCL),Bengaluru***

Duration: September 2015-August 2017

Principal Investigator: Dr. Ganapati V Shanbhag

Co-Investigator: Dr. Sanjeev P Maradur

Project fellows: Mr. Girish Kamath, Mr. Darshan Gaonkar

A new industry project sponsored by HPCL was started in September 2015 with the aim of design and development of catalyst and process for light naphtha valorization. Two project fellows were recruited in this project and required chemicals and reagents were procured.

A fixed bed down-flow quartz reactor equipped with tube furnace, temperature controller, syringe pump, cryostat etc have been set up in the initial phase of the project.Several catalyst formulations were prepared and tested for light naphtha valorization reaction. With the best performed catalyst, repeated regeneration study was conducted to test the effect on activity. The quarterly review meetings were held in February 2016 and several suggestions given by HPCL team were incorporated. Half yearly report was submitted.

Status: On going

ACADEMIC PROJECTS:

4. **Chemical fixation of CO_2 by converting into value-added chemicals using metal modified nanoporous silicate catalysts.**

(Sponsored by: Vision Group on Science & Technology, Govt. of Karnataka, 2014-2017) Center of Excellence in Science Engineering and Medicine (CESEM), ***60 Lakhs/ 3 years***

Principal Investigator: Dr. Ganapati V Shanbhag

Project fellow: Mr. Nagendra Kulal

The interview for project fellow was conducted and one candidate was recruited as Project Assistant in September 2015. Surface area analyzer, Belsorb Mini II was purchased by e-tendering under this project. The chemicals, glasswares and other required items were procured and the research work was started with preparation of various catalysts and their application in glycerol carbonylation with CO_2 to synthesize glycerol carbonate. Initially reported catalysts were prepared and tested to standardize the reactor set up and the reaction procedure. Several new catalysts were prepared and tested for this reaction. Metal composites were found to be most effective for the synthesis of cyclic carbonates. Further optimization of catalyst recipe is underway.

Status: Ongoing

5. Novel bifunctional Zn-Sn composite oxide catalyst for selective synthesis of glycerol carbonate by carbonylation of glycerol with urea

PhD supervisor: Dr. Ganapati V Shanbhag
Research Student: Mr. Manjunathan P

Preparation of Zinc-tin composite oxides using three different methods *viz.,* co-precipitation, solid state and evaporation method was studied. The catalysts physico-chemical properties were derived from X-ray diffraction, nitrogen sorption, temperature-programmed desorption of NH_3 and CO_2 and scanning electron microscopy techniques. The application of the prepared catalysts was studied for organic transformation of bio-renewable feedstock glycerol to glycerol carbonate using carbonylation of urea. As the catalyst is a composite material, it showed an excellent catalytic performed compared to individual metal oxides (ZnO, SnO_2). The pure Zn_2SnO_4 oxide showed lower catalytic activity compared to composite Zn-Sn composite oxides.

Additionally to get more insight on the most active catalyst TEM analysis was performed and the result obtained showed interesting information in the catalysts.

Status: Completed, published

6. Versatile Mesoporous SnO_2 as an Efficient Catalyst with Multifarious Application in Oxidation and Acid Catalysis

Principal Investigator: Dr. Ganapati V Shanbhag
Project fellow: Mr. Manjunathan P.

The mesoporous tin oxide was synthesized under ambient temperature using a structure directing agent and was characterized by XRD, FT-IR, SEM, TEM, TGA, N_2 sorption, TPD-NH_3, py-FT-IR and ^1H MAS NMR. Mesoporous tin oxide showed the acidic strength which decreases with increase of calcination temperature ≥350 °C. It was also observed that there was no change in the strength of acidic sites in template free and template assisted mesoporous tin oxide. However, these catalysts possess different amount of acidic sites even though the strength of acidic sites are same. In this study, the mesoporous tin oxide was used as catalyst for a series acid catalyzed organic transformation reactions *viz.*, acetalization of glycerol with carbonyl group containing molecules such as acetone, benzaldehyde and furfural. Glycerol acetalization with aldehydes and ketones results into the formation of isomeric six- and five-membered cyclic acetals. Epoxidation of cyclohexene to cyclohexene oxide.

Status: Work in progress

7. Aromatization of light naphtha from refinery over non-zeolitic non-transition metal based mesoporous alumino silicate catalyst (M. Tech. Thesis Project)

Principal Investigator: Dr. Ganapati V Shanbhag
Project fellow: Mr. Girish Kamath

Zeolites are mostly used for aromatization of light naphtha. However, they suffer from excessive cracking products with methane as a major product which has low commercial value. Also, the use of precious metals like Ga, Pt becomes expensive and transition metals like Zn are not advisable in the catalyst due to environmental issues caused by them. Hence, this project was aimed towards aromatization of light naphtha from refinery over non-zeolitic non-transition metal based solid acid

catalyst which gives low cracking products but at the same time good aromatic yield. After screening many different types of solid acid catalysts, mesoporous alumino silicate (MAS) found to be the best catalyst. It performed better than the conventional ZSM-5 catalyst without metal modification. The reaction conditions were optimized to get the high aromatic yield. Under optimized conditions MAS gave 54% conversion with 60% yield for aromatic products.
Status: Under progress

RESEARCH HIGHLIGHTS

A. Published papers (2015-2016)

1. "Novel bifunctional Zn-Sn composite oxide catalyst for selective synthesis of glycerol carbonate by carbonylation of glycerol with urea", P. Manjunathan, R. Ravishankar and G. V. Shanbhag*, **ChemCatChem** (Wiley), 2016, 8 (3), 631-639. Impact Factor: 4.55
2. "Superior performance of mesoporous tin oxide over nano and bulk forms in the activation of a carbonyl group: Conversion of bio-renewable feedstock", V. S. Marakatti, P. Manjunathan, A. B. Halgeri and G.V. Shanbhag*, **Catalysis Science & Technology** (RSC) 2016,**6**, 2268-2279. IF: 5.42
3. "Glycerol acetins: fuel additive synthesis by acetylation and esterification of glycerol using cesium phosphotungstate catalyst" S. Sandesh, P. Manjunathan, A. B. Halgeri, G. V. Shanbhag, **RSC Advances**, 2015, 5, 104354-104362. IF: 3.84
4. "Green and Sustainable Tandem Catalytic Approach for Fine-Chemicals Synthesis Using Octahedral MnO_2 Molecular Sieve: Catalytic Activity versus Method of Catalyst Synthesis". B. Sarmah, R. Srivastava,*, P. Manjunathan, and G. V. Shanbhag, **ACS Sustainable Chemistry & Engineering** (ACS), 3 (11) 2015, 2933–2943. IF: 4.64
5. "Shape-selective synthesis of para-diethylbenzene over pore-engineered ZSM-5: a Kinetic study", Janardhan L. Hodala, Yajnavalkya S. Bhat, Anand B. Halgeri† and Ganapati V. Shanbhag*, **Chemical Engineering Science** (Elsevier) 138, 2015, 396-402. IF: 2.61
6. "Influence of alkaline earth cation exchanged X zeolites towards ortho-selectivity in alkylation of aromatics: Hard-Soft-Acid-Base concept", Vijaykumar S. Marakatti, Peddy V. C. Rao, Nettem V. Choudary, GandhamSriGanesh, Gitesh Shah, Sanjeev P. Maradur, A B. Halgeri, Raman Ravishankar*, Ganapati V. Shanbhag*, **Advanced Porous Materials** (American Scientific Publishing), 2, 2014, 1-9. IF: New
7. "Metal ion-exchanged zeolites as highly active solid acid catalysts for the green synthesis of glycerol carbonate from glycerol"
   V. S. Marakatti and A. B. Halgeri ***RSC Advances***, 2015, **5**, 14286-14293, IF: 3.84

B. Papers presented in Conferences

P. Manjunathan gave Oral Presentation on his research work titled "*A novel zinc-tin composite bifunctional catalyst for the selective synthesis of glycerol carbonate via carbonylation of glycerol with urea*" at **International Conference**

on Sustainable Chemistry & Engineering (SusChemE) held at Hotel Lalit Mumbai, organized by Institute of Chemical Technology on October 8-9, 2015.

C. Review meetings:

1. GTC project review meeting

Dr. Ding ZhongYi Technology Process Manager, GTC USA visited PPISR on 27-28 April 2015 to review the progress of new GTC sponsored project started from November 2014. Previously, the Catalysis group of PPISR successfully conducted 3 years GTC sponsored project on " Design and development of catalyst and process for alkylation of aromatics" This work at PPISR led to the development of a new TolAlk technology announced world wide by GTC and subsequently licensed to a China refinery.

For the ongoing new project, there were discussions on the progress made during 6 months during the technical review meeting chaired by Dr. A. B. Halgeri. Dr. Ganapati Shanbhag and Dr. Sanjeev Maradur made technical presentations about the progress of the project and literature related to the subject. Dr. ZhongYi expressed his satisfaction on the progress and milestones achieved during this period.

2. PhD Defence VIVA of students and award of PhD degree

PhD Defence VIVA of three students; Swetha, Vijaykumar and Janardhan were conducted on during April-June 2015 in the auditorium of PPISR main campus. Defence viva of Swetha Sandesh was conducted on 16-4-2015. External examiner was Dr. B. M. Reddy, HOD Catalysis and Process Division, IICT Hyderabad.

Dr. K. R. Krishnamurthy, Chair Professor, NCCR, IIT, Madras examined Mr. Vijaykumar's thesis and came for his PhD defence on 9-5-2015. Janardhan H L's viva was conducted on 10-6-2015. Prof. Parimal Parikh, Professor from NIT, Surat came as external examiner for his defence viva and Prof. M. P. Yashoda, HOD Chemistry Dept, MIT, Manipal also present as MU representative. The students gave presentation on their entire Ph.D. work systematically. Examiners asked several questions for which students gave answers satisfactorily. Based on the recommendations of the examiners, PhD degree has been awarded to these students by Manipal University.

3. Project proposal meeting

Proposal review meeting of new HPCL sponsored project was held at PPISR on July 31, 2015. From HPCL R & D Centre, Dr. N V Choudhary (General Manager), Dr. Peddy V C Rao (Dy. Gen. Manager), Dr. Raman Ravishankar (Senior Manager) and Dr. Sudarshan Reddy attended the meeting. From PPISR, Dr. A. B. Halgeri, Dr. G. V. Shanbhag and Dr. S. P. Maradur were present. Dr. A.B. Halgeri presided over the meeting. Dr. G. V. Shanbhag gave a presentation on the new HPCL proposal. Various aspects of the proposal were discussed and few changes in the proposal were suggested.

Subsequently, Project kick off meeting was held at HPCL R & D Centre, Devanagondi was held on September 24, 2015. Dr. G. V. Shanbhag, Principal Investigator of the

project, presented the details of the final project proposal to the HPCL members. Dr. Halgeri and Dr. Maradur were also present during the meeting. HPCL team expressed their satisfaction about the proposal and gave approval for the same. Subsequently, the project was initiated by PPISR.

4. DAC meeting:

Doctoral Advisory Committee meeting to was organized the to review the six-month research progress of Mr. Manjunathan on July 6, 2015 at Sadashivnagar campus. It was Mr. Manjunathan's one and half years of doctoral research and his 3rd DAC meeting. Doctoral committee members, Prof. Y. S. Bhat, Prof. B. Chandrashekhar and Dr. Raman Ravishankar attended the meeting. Dr. G. V. Shanbhag (Guide) and Dr. S. P. Maradur (Co-guide) were present during the meeting. Mr. Manjunathan presented his six month research work and also ongoing and future activities of his research. DAC members gave several valuable suggestions to improve the quality of research.

4th DAC review meeting to was organized the to review the six-month research progress of Mr. Manjunathan on January 14, 2016 at Sadashivnagar campus. It was Mr. Manjunathan's two years of doctoral research. Doctoral committee members, Prof. Y. S. Bhat, Prof. B. Chandrashekhar and Dr. Raman Ravishankar attended the meeting. Dr. G. V. Shanbhag (Guide) was present during the meeting. Mr. Manjunathan presented his six month research work and also ongoing and future activities of his research. DAC members expressed satisfaction on the overall progess made by the student.

5. Quarterly review meeting of HPCL project

1st quarterly Project review meeting of new HPCL sponsored project was held at HP Green R & D Centre, Bengaluru on February 2, 2016. From HPCL R & D Centre, Dr. N V Choudhary (General Manager), Dr. Peddy V C Rao (Dy. Gen. Manager), Dr. Raman Ravishankar (Senior Manager) and Dr. Sudarshan Reddy attended the meeting. From PPISR, Dr. A. B. Halgeri, Dr. G. V. Shanbhag and Dr. S. P. Maradur were present. Dr. G. V. Shanbhag gave a presentation on the progress made in the project work in the first quarter and discussed the ongoing and future proposed work. HPCL team gave several suggestions which would be incorporated in the future work. They appreciated the overall progress made in the project.

D. Award

A plaque was awarded by GTC Technology Inc, USA to Catalysis Group in recognition of the successful completion of the GTC sponsored project 2013-2014 where, Catalysis Team led by Dr. G. V. Shanbhag and co-investigated by Dr. S. P. Maradur developed 2nd generation catalyst for toluene methylation process.

H.H. Sri Vishwapriya Theertha Swamiji, Chairman, AMEF honored Dr. Shanbhag and Dr. Maradur during Founders Day Programme on 24-7-2015. All the contributed students received certificates from Sri Swamiji.

E. Invited Talks

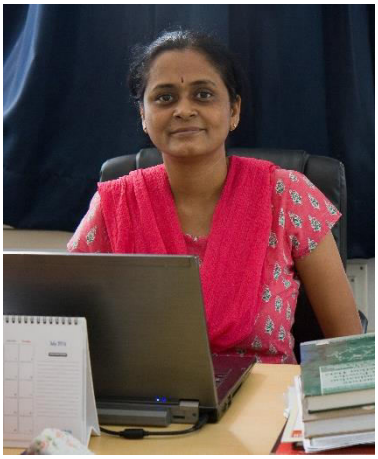
1) Dr. G. V. Shanbhag delivered an invited talk for Faculty Development Programme (FDP) on Applied Catalysis and Reaction Engineering, on the topic "Heterogeneous

Catalysis: Concept and its importance in present day research" at Department of Chemical Engineering, **M.S. Ramaiah Institute of Technology**, Bengaluru on 16-07-2015.

2) Dr. G. V. Shanbhag gave invited lecture as a resource person on two topics*i) Catalysis-Principles and applications; ii) Bio mass - Roll of catalysts for its conversion into energy and chemicals"*on 18-07-2015 at 9.00- 12.30 pm during three days Faculty Development Programme organized from in Dept. of Chemistry at **Siddhaganga Institute of Technology**, Tumkur.
3) Dr. G. V. Shanbhag delivered an invited talk for Masters Students of MIT, Manipal, on the topic "Heterogeneous Catalysis: Concept and its importance in present day research" at Department of Chemical Engineering, **Manipal Institute of Technology**, Manipal on 22-02-2016.
4) Dr. G. V. Shanbhag gave a talk on Basics of heterogeneous catalysis during **Winter School** for undergraduate students of BSc at PPISR on January 5, 2016.

F. Others

- Dr. Shanbhag, Mr. Nagendra Kulal and Mr. Darshan Gaonkar attended the 8th Bangalore India Nano Conference 2016 which was held from 3rd March 2016 to 5th March 2016 at The Lalit Ashok Convention Centre, Bengaluru.
- Mr. Nagendra Kulal and Mr. Darshan Gaonkar joined as Doctoral students
- Mr. Girish Kamath joined as MTech Project fellow on 1st July, 2015.



Dr. Nalini G Sundaram

Assistant Professor

Email:nalini@poornaprajna.org

Web: http://www.ppisr.res.in/nalinis.html

Brief Curriculum vitae

- 2010-Present: Asst. Professor, PPISR, Bengaluru, India.
- 2005-2008: Postdoctoral Researcher, Dept. of Physics,University of California, Santa Cruz, USA.
- 2004-2005: Postdoctoral Reseacher, Los Alamos National Laboratory, New Mexico and Stanford Synchrotron Laboratory,Stanford, U.S.A
- 1997-2003: Ph.D. Solid State Chemistry ,Indian Institute of Science, Bengaluru, India, 2003

Research Areas of Interest

- Oxide nanoparticles, Nanocomposites and Thick films selective Gas Sensors
- Rare Earth Photoluminescent nano-oxides for solid state lighting devices
- Ceramic Nanomaterials Photocatalysts for dye degradation and organic reactions
- Lead free relaxor ferroelectric materials
- Structure-Property Relationships in Functional energy nanomaterials
- Synthesis, structural studies, polymorphism, local structure and phase transitions in multifunctional materials using Single Crystal Powder X-ray as well as Neutron diffraction techniques

Awards and Scholarship

1. Awarded a project by DST, India for three years under the SERC- Fast Track Scheme For Young Scientists (FAST)
2. Senior Research Fellowship from Council of Scientific and Industrial Research (CSIR)

   Government of India
3. Recipient of the Joshi award for securing first rank in M.Sc. (Physical Chemistry)

Sponsored Projects at PPISR

- **Sanctioned**: Phase Transitions in $BiMWO_6$ (M=Ce,fe,Cr) Smart Functional Nanomaterials by **UGC-DAE CSR Mumbai Centre, India for three years (2016-2019)**

- **Ongoing**: "Design and development of lanthanum based nanoparticles for Thick film gas Sensors.": Sponsored by DST-India, Under Extra Mural Research grant (April 2015-April 2018)

- **Ongoing**: Influence of Electron Beam Irradiation on the Crystal Structure and Photoluminescence of Rare Earth doped Tungstate Nanophosphors: Sponsored by **BRNS, DAE**, India for three years (April 2013-Apr 2016)

- **Completed**: Design and Development of Nanocrystalline Bismuth Oxychlorides for Degradation of dyes and Organic Pollutants: Sponsored by **DST, India**, under the Fast track scheme for Young Scientists for three years (Jan 2012- Jan 2015)

Representative publications

1. $Na_{2.44}Mn_{1.79}(SO_4)_3$: a new member of the alluaudite family of insertion compounds for sodium ion batteries Debasmita Dwibedi, Rafael B. Araujo, Sudip Chakraborty, Pradeep.P. Shanbogh, **Nalini G. Sundaram**, Rajeev Ahuja and Prabeer Barpanda ***J. Mater. Chem. A***, 2015**,3**, 18564-18571
2. **Invited** article titled 'Fullerenes Revisited: Materials Chemistry and Applications of C60 Molecules' Pradeep P. Shanbogh Nalini G. Sundaram, **Resonance**, February 2015, 20 (02), (p.123)
3. Photocatalysis of Bi4NbO8Cl hierarchical nanostructure for degradation of dye under Solar/UV irradiation,Swetha S M Bhat and Nalini Sundaram ***New J. Chem.***, 39,3956-3963, 2015
4. Controlled inversion and surface disorder in zinc ferrite nanocrystallites and their effects on magnetic properties, Ranajit Sai, Suresh D. Kulkarni, Swetha S. M. Bhat, Nalini G. Sundaram, Navakanta Bhat and S. A. Shivashankar ,***RSC Adv.***, 2015,**5**, 10267-10274
5. 'Photoluminescence tuning of Na1_xKxNdW2O8 (0.0 r x r 0.7) nanoparticles: synthesis, crystal structure and Raman study' Swetha S. M. Bhat, Ashfia Huq, Diptikanta Swain, Chandrabhas Narayana and **Nalini G. Sundaram, *Phys.Chem.Chem.Phys***.,2014, 16, 18772

   Total Number of Publications in National and International Journals: 22

Research Group

1. Post Doctoral Researcher:

Dr. Sowmya Palimar, (Ph.D from NITK Surathkal)

Research Area:

Development of Lanthanum based Oxide Thick films for selective Gas sensors

Graduate (Ph.D) students:

1. Mr. Pradeep Shanbogh (SRF supported by BRNS)

Research Area

Rare earth doped Complex Bismuth oxide Nanoparticles for Photoluminscent and Photocatalytic Applications

2 Ms. Archana. K. M (JRF Supported by PPISR)

Research Area

Development of Complex Oxide Nanomaterials for Gas sensors and Photoluminescent Applicatoins

International and National Collaborators

- Professor. Pandurang Ashrit, University of Moncton, Moncton, Canada
- Professor Navakanta Bhat, CeNSE, IISc
- Dr. Andrea Lausi, Elettra, Trieste
- Dr. Mikhail Feygenson, European Sphallation Source
- Dr. Joerg Neuefeind, ORNL
- Dr. Ashfia Huq, ORNL
- MOU with APS, Argonne National Laboratory, Chicago
- Dr. Abhishek Mishra, UCL, London
- Dr. Prabeer Barpanda,IISc
- Professor. Shivashankar, IISc
- Professor Chandrabhas Narayan, JNCASR
- Dr. Diptikanta Swain, IISc

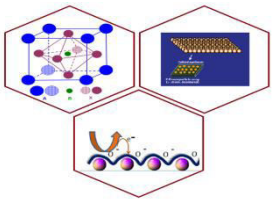
Current Research Projects

1.Design of Lanthanum based Perovskite Nanoparticles for the Development of Thick Film Gas Sensor

Name of the Primary Investigator: **Dr. Nalini G. Sundaram**

Name of the Postdoctoral Fellow: Dr. Sowmya Palimar

Main objective of the proposed project is to synthesize, and characterize Lanthanum (La) based perovskite nanoparticles to develop them as selective and sensitive thick film gas sensors to detect toxic and flammable gases. Proposed work aims to synthesize p-type Lanthanum based perovskite nanoparticles of the general formula La1-x AxBO3 (Here A=Sr, Ca, Ba etc and B=Fe or Ni or Co.), using suitable synthetic techniques. The work involves investigation of the effect of substitution and particle size on the crystal structure of the nanoparticles and then to obtain good quality thick films from the particles in order to study their sensing properties to different gases such as sulphure dioxide acetone, ammonia, hydrogen sulphide, hydrocarbons and L.P.G. Sulphur dioxide (SO_2) is a highly toxic gas which is released during various reactions in chemical and petrochemical industries. This gas posions the victim by inhalation through lungs and the threshold limit of this gas is 5 ppm. Thus there is a great demand to develop low concentration SO_2 gas sensor. To establish selectivity further gas sensing study was performed with methane. We observed $La_xCa_{(1-x)}FeO_3$ pellets

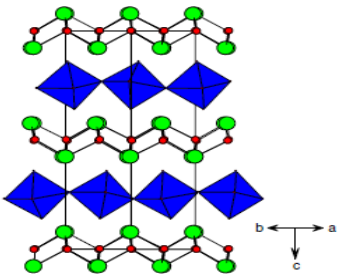


showed a significantly good response to SO_2gas at a lower temperature with remarkably good response and recovery time, whereas at this temperature a significantly low response was seen for higher ppm of CH_4.

2. Synthesis of $Bi_{2-x}RE_xWO_6$ (*RE* = Nd, Eu, Tb) Nanoparticles for their Photoluminescent and Photocatalytic Activity

Primary Investigator: **Dr. Nalini G. Sundaram**

Research Student: Mr. Pradeep shanbogh



Aruvillius phases with layered perovskites are shown to be good photocatalysts and better luminescent materials. Bi_2WO_6 is the basic structure in the layered perovskite structure, which exhibits polymorphism, hence crystallographically also very interesting to explore the structure-property relationship. Nanoparticles of rare earth ion substituted Bi_2WO_6 were synthesized by varying temperature, pH and composition. The obtained nanoparticles were characterized by PXRD, PL and photocatalytic activity of the materials are being studied

3. Design of $Bi_{2-x}Gd_xWO_6$ (x = 0.2,0.4,0.5,0.6,0.8 and 1) Nano photocatalysts for Degradation of Organic Pollutants.

Name of the Primary Investigator: **Dr. Nalini G. Sundaram**

Name of the Research Student: Mr. Pradeep Shanbogh

Name of the M.Tech Project Student: Mrs. Uma

Aruvillius phase layered perovskites are shown to be good photocatalysts and better luminescent materials. Bi_2WO_6 is the basic structure in the layered perovskite structure. Synthesis of $Bi_{2-x}RE_xWO_6$ (RE = Gd) was considered for the above project. In this quarterly period we have synthesized $Bi_{2-x}Gd_xWO_6$ (x = 0.2, 0.4, 0.5, 0.6 0.8 and 1) at neutral pH by conventional Hydrothermal method. These materials were characterized by powder X-Ray Diffraction measurement. Photocatalytic activity of these nanoparticles was carried out for degradation of Congo-red under sunlight. A preliminary result shows that, increased photocatalytic activity has been observed for the lower substitution of Gd3+ ion.

4. **Design, Crystal structure and Photoluminescence of $Li(RE)W_2O_8$ (RE=La,Ce,DyYb) Polymorphs**

Name of the Primary Investigator: **Dr. Nalini G. Sundaram**

Name of the Research Student: Ms. Archana. K. M

The alkali rare earth double tungstate materials with general formula ARE(WO4)2, A-Alkali metal ion and R-rare earth ion are found to be multifunctional used as solid state luminescent hosts and undergo high temperature polymorphic phase transition that results in a different luminescence properties. First time polymorphism observed in these materials by different synthesis methods. These materials show PL in red and green region. These are promising potential for up conversion materials. They are a very important class of compounds for both solid state lighting devices as well as biological applications.Currently, tetragonal and monoclinic polymorphs of LiYbW2O8 nanoparticles were synthesized by conventional

hydrothermal and solution combustion method Photoluminescent measurements of these materials was carried out and found that both compounds show good emission in the visible region.

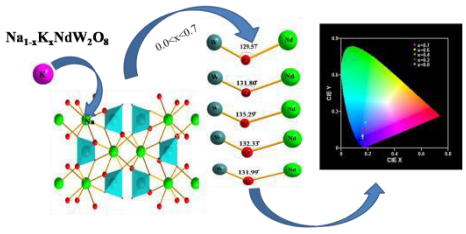
5. Design of Transition Metal Oxide -SnO_2 Based Nanocomposites for Highly Selective Gas Sensors

Name of the Primary Investigator: **Dr. Nalini G. Sundaram**
Name of the Research Student: Ms. Archana. K. M
Name of the M.Tech Student: Mr. Bharath.V
Tin oxide has been proven to be a highly gas sensitive material for detection of both reducing and oxidizing gases. However it has a few disadvantages such as low selectivity, low stability and higher operating temperature. Hence our approach is to couple n-type semiconducting SnO2 to V2O5, Nb2O5 and Ta2O5 to derive a nanocrystalline composite as a selective gas sensing material. SnO2 was prepared by conventional different surfactant assisted hydrothermal and Co-precipitation methods. SnO2 was characterized by p-XRD. Preparation of SnO2-V2O5, SnO2-Nb2O5 and SnO2-Ta2O5 nanocomposite work is underway.

6. Structural Analysis of Lead Free Relaxor Dielectrics with TiO_2 Rutile Structure

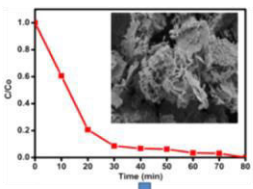
Name of the Primary Investigator: **Dr. Nalini G. Sundaram**
Name of the Postdoctoral Fellow: Dr. Sowmya Palimar
Multiferroic oxides have wide range of applications as sensors, transducers and other switching devices Eg:Novel relaxor ferroic oxides, $FeTiTaO_6$, $FeTiNbO_6$. Low-temperature dielectric measurements depict anomalous dielectric relaxations with frequency dispersion in these materials. To investigate the dielectric anomalies a series of solid solutions of $FeTiTa_xNb_{1-x}O_6$ (x = 0, 0.2, 0.5, 0.8, 1) using high temperature sold state reactions was synthesized and low temperature X-ray data from 20K to 300K were collected.The dielectric anomalies reported are clearly seen in the variations in cell parameter and volume of the unit cell with temperature

Some Completed Research Projects:



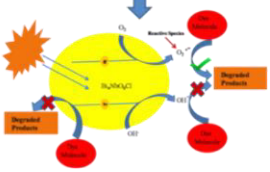
***(a)* Photoluminescence Tuning of $Na_{1-x}K_xNdW_2O_8$(0.0≤ x ≤0.7) Nanoparticles; Synthesis, Crystal Structure and Raman Study**

; *Duration: 2011-2013*
Primary Investigator: **Dr. Nalini G Sundaram**
Research Student(JRF): Ms. Swetha S.M
Published in Physical Chemistry Chemical Physics
RSC Publications, 2014



(b)Photocatalysis of Bi_4NbO_8Cl hierarchical nanostructure for degradation of dye under Solar/UVirradiation

Primary Investigator: Dr. Nalini G. Sundaram
Research Student: Ms. Swetha. S. M.
Published in New Journal of Chemistry,
RSC publications, 2015



(c) Controlled inversion and surface disorder in zinc ferrite nanocrystallites and their effects on magnetic properties

Primary Investigator: **Dr. Nalini G. Sundaram**

Research Student: Ms. Swetha. S. M.

Published in RSC Advances, RSC Publications, 2015

Future Projects

1***. Bandgap Engineering of Rare Earth Doped Bismuth Heterostructures for Dye Degradation and Photochemical Reactions***

Funding Agency Considered: MNRE, DST, India

The key challenge in this project is to selectively oxidize glycerol to a particular product using environmental friendly methods. In this regard, photocatalysis is one of the green processes that have been used in recent times for degradataion of dyes and also for organic reactions. This project aims to design novel Bismuth based nanomaterials as photocatalysts using various synthesis strategies in order to selectively oxidize glycerol to value added products.

2.Design of Transition Metal Oxide Thin Films for Chromogenic and Gas Sensing Applications

Funding Agency Considered: Indo-Canada DST, ndia

The key challenge in this project is to design thin films of TMO oxides such as V_2O_5, WO_3 etc. via simple chemical methods and apply it in the thin film form and later device form for both gas sensing as well as chromogenic applications.

3. *Bandgap Engineering of Rare Earth Doped Bismuth Heterostructures for Dye Degradation and Photochemical Reactions*

Funding Agency Considered: MNRE, DST, India

The key challenge in this project is to selectively oxidize glycerol to a particular product using environmental friendly methods. In this regard, photocatalysis is one of the green processes that have been used in recent times for degradataion of dyes and also for organic reactions. This project aims to design novel Bismuth based nanomaterials as photocatalysts using various synthesis strategies in order to selectively oxidize glycerol to value added products.

Membership of Professional bodies*:*

1. Member of National crystallographic Association

Best Presentation awards

- Poster titled “Local and Average structure of Bi*RE*WO_6 (RE = Eu and Tb) nano photocatalyst”.” by Mr. Pradeep.P. Shanbogh and **Nalini.G.Sundaram** was selected for the **Best Poster Award** at the13th Asian Crystallographic Association conference, Held at Kolkata in December 2015

- The **best poster prize** for the poster titled “Sunlight driven Photocatalytic Degradation of Congo-Red by RE substituted Bi2WO6” by Mr. Pradeep P. Shanbogh and **Nalini G. Sundaram** was awarded at Two Day workshop on Crystallography in The Sciences (A celebration of the

International Year of Crystallography 2014) held at Bangalore University in October 2014

- **Travel Award and Rising Star Oral Presentaion award** for Abstract titled *"Crystal structure, local structure and photoluminescence property of* $KNdW_2O_8$*polymorphs"*(Swetha.S.M. Bhat, Diptikanta Swain, Chandrabhas Narayana, Mikhail Feygenson, Joerg C Neuefeind and **Nalini G Sundaram**)at the 12th conference of the Asian crystallographic Association (AsCA) held at Hong Kong on 7th-10th December 2013.

- **Best Presentation award** for abstract titled "*Crystal Structure of Nanocrystalline Layered Bismuth Oxychlorides and their Photocatalytic Activity"* (Swetha.S.M. and Nalini G Sundaram) at the 41st National Seminar on Crystallography (NSC) held at CLRI, Chennai on Oct 8th-10th 2012

Research Highlights

- Dr. Nalini and Mr. Pradeep visited the National Institute of Materials Physics in Magurele/Bucharest, Romania on 29th and 30th March, 2016 to carry out HRTEM measurements for the proposal titled "Evaluation of Micro structure and Phase Composition of Bi2-xGdxWO6(x = 0.2 to 1) Mixed phase Nano Photocatalysts." The accommodation and Fight tickets are funded by the Central European Research Infrastructure Consortium (CERIC) funding

- Mr. Bharath's project titled "Design and Development of Multifunctional SnO_2-X_2O_5 (X=Ta, Nb) Nanocomposites and thick films for Photocatalytic and Gas Sensor Applications" applied under the **TRIP (Technology Related Innovative Projects)** Sponsored by VGST for B.E/B.Tech and M.E/M.Tech students has been accepted for a period of 5 months. He has been awarded an amount of Rs. 40,000 for 5 months to under my supervision at PPISR

- Invited as a resource person to deliver a talk on "Rietveld Refinement Method" at the UGC sponsored workshop on "Structural Analysis Through X-ray Diffraction" organized by the Physics Department, Pondicherry University from Jan 28-30, 2016.

- Invited as a resource person to deliver a talk and hands on demonstration on **Advanced Rietveld Refinement Techniques**, organized at the Srinivasa Ramanujam Institute of Basic Sciences by the Kerala State Council for Science, Technology and Environment **(KSCSTE)** from September 11-13th 2015.
- Invited to deliver a lecture at CMRIT, Bengaluru, on "Analysis of Powder Diffraction Data by Computational Techniques: The Rietveld Method" at the workshop on "**modeling and simulation of Multiscale Systems**" held at CMRIT, Bengaluru, on 9th and 10th July 2015**.**

- Invited to **deliver a lecture at** MRC, IISc on Rietveld Refinement Method in February 2015
- Beam time awarded to many proposals submitted for **Neutron and Synchrotron beam time** at national and international laboratories such as **BARC, Oakridge National Laboratory, USA, Elettra, Trieste, Italy, APS, Argonne, USA etc.** Periodic collaboration are in progress with the scientists in these laboratories
- Invited to **deliver a Lecture** at the **43rd National Seminar on Crystallography** held in IISER Mohali between 28th and 30th March, 2014 as part of the **International Year of Crystallography-2014**
- . The proposal titled "Influence of Compositional Phase Transition on the Sunlight driven Photocatalysis observed in Rare Earth (RE=Eu, Tb) substituted Bi2WO6 Nanoparticles" was awarded beamtime from February 9th to 12th at the Elettra Synchrotrone, Trieste. Dr. Nalini and Mr. Pradeep were supported by the Indo-Italian S&T agreement for travel to Italy for data collection
- **Hands-On Rietveld Refinement Workshop at MRC, IISc, Bengaluru**Dr. Nalini was invited by Prof. Umarji, Chairman, MRC, IISc, to conduct a 5 days hands on workshop on "X-ray Rietveld Refinement" using the program GSAS-EXPGui at MRC from February 25 –March 3 2015. This was a unique program where in all the participants ran through the technique simultaneously following the instructions. The workshop was attended by about 40 students and some faculty. A high tea was arranged by Professor. Umarji on 3rdMarch to consolidate the successful completion of the workshop.

- Dr. Nalini G Sundaram is a **reviewer** of Journal of Applied Crystallography and Materials Research Bulletin

- **Thesis Defence**: Ms. Swetha S. M. Bhat and Mr. Srinidhi Raghvan defended their PhD thesis to Manipal University through PPISR, in March and June 2015 respectively.

Dr. Sanjeev P Maradur

Assistant Professor

E-mail: sanjeevpm@poornaprajna.org

BRIEF CV:

- 2012-Present: Asst. Professor, PPISR, Bengaluru, India.
- 2011-2012: Postdoctoral Research Associate, Dept. of Chemistry, University of Oklahoma, USA.
- 2010-2011: Postdoctoral Student, Alan MacDiarmid Energy Research Institute (AMERI), Chonnam National University, Gwangju, South Korea.ese
- 2009-2010: Postdoctoral Scientist, Dept. of Chemistry, Korea Advanced Institute of Science and technology (KAIST), Daejeon, South Korea.
- 2007-2009: Research Scientist, Jubilant Life Sciences Ltd, Noida, India.
- 2006-2007: Senior Research Fellow, Dept. of chemistry, IIT-Bombay, Mumbai, India.
- 2003-2006: Ph.D. Dept. of Chemistry, Shivaji University Kolhapur, India.

RESEARCH INTERESTS:

1. **Synthesis and catalytic investigation of nanoporous materials**: Nanoporous materials have gained scientific and technological importance because of the presence of their pore structures of tunable dimensions at nanometer scales. Over the last few decades, there has been an ever increasing interest and research effort in the synthesis, characterization, functionalization of nanoporous materials. The challenges in research include the fundamental understanding of structure-property relations and tailoring of nanostructures for specific properties and applications. The main research focus of our group is the synthesis and characterization of nanostructured catalysts for various applications. Among the priorities are the development of materials with ordered porosity, search for new and improvement of existing catalytic systems, and studies of intimate mechanisms of heterogeneous reactions and reactant-to-surface reactions, identification of active sites.

2. **Heterogenization of homogeneous catalysis & its application on various chemical processes**: Development of new, highly efficient heterogenized catalysts is an active and important area in fine chemical synthesis. Homogeneous catalysis though has witnessed significant growth in the last few decades in terms of high selectivity, TON and TOF's, however the success in catalyst and process development has not been in parallel by similar growth on industrial scale. Supports play a significant role in such systems. The micro environment around the catalyst active site will be the deciding factors in achieving high conversions with high selectivity. Heterogenization of homogeneous catalysts onto supports such as zeolites, nanoporoous materials like silica and polymers would be of much interest in design and development of processes for fine chemical production.

3. **Value addition of biomass platform chemicals**: The organic transformation of glycerol by eco-friendly routes has gained significance only after the recent evolution of biodiesel technology. Once considered a valuable co-product, crude glycerol is rapidly becoming a waste product with an attached disposal cost. Therefore, the search is on to use the product in alternative markets or to develop new markets for it. We are working on development of new catalytic systems for glycerol conversion into more value added products.

RECOGNISTIONS:

- Awarded Seed Money for Young Scientist Research Grant from Vision Group on Science and Technology, Govt of Karnataka (2014).
- **Referee for international journals** *viz.* Fuel Processing Technology and Catalysis Communications.
- Received '**plaques**' from **GTC Technology Inc. USA** in 2015 in recognition of the milestones achieved as a member of the group in developing a modified zeolite catalyst for aromatics technology.

BOARD/MEMBERSHIP

- Life member of Catalysis Society of India
- Member, The International Zeolite Association (IZA) (2010-present)

Patents

1. Inventors: RyongRyoo, Dae-Heung Choi, **Maradur Sanjeev** "Production method of mesoporous organic polymer catalyst, mesoporous organic polymer catalyst produced using the method, and process for epoxidation of olefins using the catalyst". Korean Patent Registration number: 1011704860000, Dated 2012/07/26 (**Granted**).
2. Inventors: Yang, KapSeung. **Maradur Sanjeev P.,** Kim YeongCheol. "Method for preparation of carbon fibers using lignin copolymer and the carbon fibers thereby". Korean Patent Registration number: 1012261910000, Dated 2013/01/18 (**Granted**).

PUBLICATIONS 2015-16:

1. "Molybdenum oxide/g-alumina: an efficient solid acid catalyst for the synthesis of nopol by Prins reaction" Vijaykumar S. Marakatti,Dundappa Mumbaraddi, Ganapati V. Shanbhag, Anand B. Halgeri and Sanjeev P. Mardaur*__RSC Advances,__ 2015, 5, 93452-93462.
2. "*Sulfonated Mesoporous Polydivinylbenzene (PDVB) as Efficient Catalyst for Room Temperature Synthesis of Solketal*" Sathyapal R. Churipard, Pandian Manjunathan, Prakash Chandra, Ganapati V. Shanbhag, A.B. Halgeriand Sanjeev P. Mardaur*. **Manuscript under preparation.**
3. *"Application of Sulfonated Mesoporous Polydivinylbenzene (MP-SO_3H) Catalyst for Etherification of Glycerol with tert-Butanol"* Pandian Manjunathan, Manish Kumar, Sathyapal R. Churipard, S Sivasankaran, Ganapati V. Shanbhag and Sanjeev P. Maradur***Manuscript under Preparation.**

STUDENTS

PhD students

1. Sathyapal R. Churipard
2. Kempanna S. Kanakikodi

M. Tech Project Fellows

3. Manish Kumar
4. Sharath Ravi

RESEARCH

SPONSORED PROJECTS:

1. **Design and development of a catalyst and process for selective methylation of benzene/ toluene to produce *p*-xylene**
   *(Sponsored by: **GTC Technology, USA**)*
   Principal Investigator: Dr. Ganapati V Shanbhag
   Co-Investigator: Dr. Sanjeev P Maradur
   Research Fellows: Mr. Santosh Kumar, Mr. Saikiran M., Mr. Kempanna

   Toluene/benzene alkylation with methanol was continued using modified zeolite catalyst as a part of development of 2nd generation catalyst for TM process. Two reactor in series was set up for toluene methylation to produce xylenes. The 1st generation catalyst was used in the series reactor. Time on stream experiments for 150 hours were conducted to study the performance under various conditions and catalyst life time. The toluene conversion was almost twice than the single reactor and catalyst life time increased with series reactor. Furthermore, benzene methylation was also tested in series reactor aimed to achieve high benzene conversion with long catalyst life. Around 150 hours' time on stream studies were conducted and the detailed confidential report was submitted to GTC
   Status: Completed
2. **Catalytic Conversion of Waste Plastics into Liquid Fuels**
   *(Sponsored by: **Thermax Industries, Pune**)*
   Principal Investigator: **Dr. Sanjeev P. Maradur**
   Co-Investigator: Dr. Ganapati V Shanbhag

Research Students: Mr. Manish and Mr. Sathyapal,

The objective of the project is to develop catalysts for the conversion of waste plastic to Oil. The project will be executed in two parts. First Part will be supply of zeolite catalyst material in extrudate form for initial screening purpose along with compressive literature survey and analysis method development for catalyst characterization

As per the project requirements we had supplied 5 kg of catalyst material to Thermax for evaluation studies and the results are promising. The technical review meeting was held at Thermax in Pune regarding the progress of the project. Potential catalyst have been identified and recommended to Thermax for further screening. A compressive Literature report on the subject has also been submitted anlog with a document on development of analysis methods for the characterization of zeolite samples.

Status: Completed

3. **Development of Novel Mesoporous Polymer Based Catalysts for Low Temperature Catalytic Applications**

(Sponsored by: Hindustan Petroleum Green Research and Development Centre, Bengaluru*)*

Principal Investigator: **Dr. Sanjeev P. Maradur**

Co-Investigator: Dr. Ganapati V Shanbhag

Research Students: Mr. Sathyapal and Mr. Kempanna. K

This proposed research involves the preparation of a new class of advanced structured polymers as heterogeneous catalysts which may overcome the problems and limitations of the commercial polymeric supports for low temperature catalytic applications.

A novel mesoporous polymeric solid acid catalyst will be prepared by incorporation of suitable acid functionality either during polymerization or post synthetic modification and will be applied for important organic transformations *viz.* oligomerization of olefins and etherification of glycerol by *tert*-butanol to produce *tert*-butyl ethers of glycerol, a potential fuel additive.

Status: Ongoing

ACADEMIC PROJECTS:

4. **Molybdenum oxide supported onto alumina calcined at high temperature: A promising catalyst for nopol synthesis**

PI: **Dr. Sanjeev P Maradur**

Co-PI: Dr. Ganapati V Shanbhag

Reserach Students: Mr. Dundappa and Mr. Vijay Kumar

The Prins reaction is an important synthesis. It is an acid catalyzed condensation of olefin with aldehyde leading to the formation of synthetic organic chemicals like 1,3-dioxanes and unsaturated alcohol. The condensation product of β-pinene and paraformaldehyde, is generally used in the agrochemical industry to produce pesticides and also in manufacturing household products such as soaps, detergents and polishes. In accordance with the concept of green chemistry, heterogeneous catalysts were widely

explored and utilized in this reaction. Many of the reports for Prin's reaction are tin based catalysts and also the catalyst to substrate ratio is more in most of the cases. From green chemistry point of view, it is worth exploring a novel efficient catalyst with less toxic or non toxic in nature and which will overcome the problems associated with the already reported catalyst systems.
Status: Completed

5. **Sulfonated Mesoporous Polydivinylbenzene (PDVB) as Efficient Catalyst for Room Temperature Synthesis of Solketal**

PI: **Dr. Sanjeev P Maradur**

Co-PI: Dr. Ganapati V Shanbhag

Reserach Students: Mr. Sathyapal, Mr. Manjunathan P

Sulfonic acid functionalized mesoporous polymer catalyst (MP-SO_3H) was prepared by post synthetic modification of mesoporous polydivinylbenzene by incorporating sulfonic acid moiety using conc. H_2SO_4. The synthesized materials were characterized by using several physicochemical techniques and their performance was evaluated for room temperature liquid phase acetalization of glycerol with acetone. MP-SO_3H catalyst performed better than other conventional solid acid catalysts with 94 % glycerol conversion and 98.5 % selectivity for solketal. The high activity of MP-SO_3H catalyst can be attributed due to facile diffusion of reactants and products in the mesoporous environment together with an optimized balance of acid functionalization. Glycerol conversion increased with increase in the total acidity of the catalyst. Amount of acidity and surface density of (H^+) ions were found to have a direct correlation with catalyst performance.

Status: Manuscript is under preparation

6. **Design of novel mesoporous polymers as catalyst for the synthesis of glycerol derivatives, potential fuel additive molecules for diesel and gasoline**

PI: **Dr. Sanjeev P Maradur**

Co-PI: Dr. Ganapati V Shanbhag

Reserach Students: Mr. Manjunathan P, Mr. Manish Kumar and Mr. Sathyapal,

This proposed research involves the preparation of a new class of advanced structured polymers as heterogeneous catalysts which may overcome the problems and limitations of the commercial polymeric supports or the production of fuel additives from glycerol originating from biomass. Recently, mesopolymers having pure organic frameworks have been discovered. The inclusion of functional groups onto mesoporous polymers will be investigated for conversion of glycerol which is available in plenty which comes out as by-product from biodiesel industry into valuable chemicals which may find applications as fuel additives in automobile industries.

Status: Manuscript is under preparation

7. **Synthesis of peroxotungstate supported mesoporous polymer for oxidation reactions with hydrogen peroxide**

   Research Guide: **Dr. Sanjeev P. Maradur**

   Reserach Student: Mr. Sathyapal

   The development of environmentally friendly techniques in the field of oxidation of organic compounds has attracted much attention because the reagents used in stoichiometric amounts in these reactions are sometimes wasteful and toxic. Therefore, there is an urgent need to replace the classic oxidants with "clean" oxygen donors, such as H_2O_2. In this concern, tungsten-based catalysts have attracted significant attention in recent years, owing to their very high efficiency of H_2O_2 utilization. Heterogenization of tungsten based catalyst onto mesoporous polymer will be very interesting from operational point of view especially when H_2O_2 is used as oxidant.

   Status: Ongoing

8. **Catalytic conversion of biomass derived alcohols into aromatics by MFI Zeolite: Effect of porosity and modification against catalytic activity**

   Research Guide: **Dr. Sanjeev P. Maradur**

   Reserach Students: Mr. Sharath Ravi, Mr. Manish Kumar

   Benzene, toluene, and xylene (BTX), are a class of aromatic feedstocks for large-scale chemical industrial processes. The traditional methods of production of these products streams are either from catalytic reforming of naphtha, selective disproportionation alkyl aromatics and alkylation of hydrocarbon and both of which have been well developed in the petrochemical industry. All of these mature processes are based on the nonrenewable resources of petroleum, coal, and natural gas. However, concerns about the depletion of fossil reserves have stimulated the investigation of sustainable processes for the production of BTX. Production of aromatics from renewable biomass resources could provide sustainable alternatives to fossil-based processes. So far, biomass-derived ethanol, glycerol, n-butyl alcohol/ acetone and a mixture of C2−C5 alcohol have been reported as feedstocks in the production of aromatics. However during these processes, the fast catalyst deactivation is a major hurdle in development of process technology.

   In this research, we are going to study the effect of porosity and modification of Zeolite MFI catalyst for retardation of catalyst deactivation during the conversion of biomass derived alcohols i.e. ethanol and biobutanol into aromatics.

   Status: Ongoing

RESEARCH HIGHLIGHTS

1. Dr. Maradur presented a literature survey on methyl bromide to value added products during Dr. ZhongYi. Ding, GTC, USA on 28th April 2015.
2. Dr. Maradur and Dr Shanbhag had a technical meeting with Thermax Scientistsfor a sponsored project on Plastics to Fuels on 10th June 2015. Dr. Nagesh. Kini from Thermax and Prof Umarji, Materials Research Center, IISc

were present during the meeting.

3. Mr. Manish Kumar, M. Tech Project fellow under the guidance of Dr. Maradur has submitted his M. Tech Thesis on 25th June 2015 to Chem Eng Department, Manipal University.
4. DAC meeting for Mr. Sathyapal's Ph.D registration was held on 29th May 2015 and he made a presentation on the proposed work for PhD. The DAC members recommended Mr. Sathyapal for registration of PhD to Manipal University. Subsequently his proposed research was approved by Manipal University for PhD registration in July 2016.
5. Mr. Sharat Ravi from Manipal University has joined under Dr. Maradur for his M. Tech Project from Aug 2015 to July 2016. He will be working on catalytic conversion of biomass derived alcohols into aromatics.
6. Dr. Maradur visited Thermax Industries Pune on 10-11th Sept 2015 for project review meeting. The sponsored project on Plastics to Fuels was successfully completed with the submission of final report to Thermax.
7. Mr. Satyapal R. C. made a poster presentation onSulfonated Mesoporous Polydivinylbenzene (PDVB) as Efficient Catalyst for Room temperature Synthesis of Solketal at Sustainable Chemistry and Engineering (SusChemE)" organised by Institute of Chemical Technology (ICT), Mumbai on 8-9th October 2015.
8. Mr Kempanna S. Kanakikodi has joined Dr Maradur's research group for his PhD program from November 2015. Soon he will be registering for PhD to Manipal University.
9. Mr Satyapal and Mr Kempanna have been appointed as Research Fellows in a HPCL Sponsored Project on "**Development of Novel Mesoporous Polymer Based Catalysts for Low Temperature Catalytic Applications" from February 1st, 2016.**

REVIEW MEETINGS

1. **Thermax Sponsored Project**

   A short term project (Jul – Sept 2016) sponsored by Thermax Industries, Pune on "Conversion of waste plastics to fuels" **with Dr Maradur as PI and Dr Shanbhag as Co-PI** was completed successfully. Project review meeting was held at Thermax R&D on 10-11th Sept 2016 in order to discuss the progress made during this period. Dr. Kalyan Raman, Mr. Charles Philomin, Dr. Nagesh Kini, Mr. Srinivasa Rao Atchuta, Mr. Shriraj Misal and Ms. Dipti Dwivedi participated from from Thermax and Dr. A.B. Halgeri, and Dr. Sanjeev Maradur was present for PPISR.

2. **New HPCL Sponsored Project**

   Another project has been sanctioned by HPCL R & D which started from 1st Feb 2016 for a period of two years. The research work is aimed at "**Development of Novel Mesoporous Polymer Based Catalysts for Low Temperature Catalytic Applications" with Dr Maradur as PI and Dr Shanbhag as Co-PI. The Project kickoff meeting was held on 2nd Feb 2016.** Dr. Maradur made a presentation on the research topic undertaken in the sponsored project and action the plans of executing it. Several points were discussed during the meeting which included preparation of novel catalyst systems, model test reactions and target products. Dr. N V Choudhary, Head R&D, Dr. P.V.C. Rao, General Manager, R & D, Dr. Ravishakar, Chief Manager, Dr. Siva Kesava Raju and Dr. Sudarshan Reddy

participated in the meeting from HPCL side. And from PPISR, Dr. A.B. Halgeri, Dr. S. P. Maradur, Dr. G. V. Shanbhag, Mr. Girish Kamath and Mr. Darshan Gaonkar were present during the meeting. The project has been initiated with the hiring of two research fellows from 1st February 2016.

3. Doctoral advisory committee (DAC) meeting

1st DAC meeting for **Mr. Satyapal R. C.,** was held at sadashivanagar campus on February 19, 2016. Prof. Y.S. Bhat, BIT, Bengaluru and Prof. N. Nagaraju, St Joseph College, Bengaluru, were present as external subject experts. Satyapal presented his first six-month research work. The experts gave several suggestions to improve the quality of the work. The committee appreciated the progress made by Satyapal during last 6 months.

Award

A plaque was awarded by GTC Technology Inc, USA to Catalysis Group in recognition of the successful completion of the GTC sponsored project 2013-2014 where, Catalysis Team led by Dr. G. V. Shanbhag and co-investigated by Dr. S. P. Maradur developed 2nd generation catalyst for toluene methylation process.

H.H. Sri Vishwapriya Theertha Swamiji, Chairman, AMEF honored Dr. Shanbhag and Dr. Maradur during Founder's Day Programme on 24-7-2015. All the contributed students received certificates from Sri Swamiji.

Dr. Suresh B. Kalidindi

DST-INSPIRE faculty

Assistant Professor

E-mail: sureshk@poornaprajna.org

BRIEF CV:

- Aug 2015-present: DST-INSPIRE Faculty/Assistant Professor. PPISR, Bengaluru.
- Sept 2013-July 2015: Postdoctoral Research Associate, University of Liverpool, United Kingdom.
- Aug 2011-Sept 2013: Alexander von Humboldt Fellow, Max Planck Institute for Intelligent Systems, Stuttgart and Ruhr University, Bochum, Germany.
- May 2010-July 2011: RD-IFSC Post-doctoral Fellow, Ruhr University, Bochum. Germany.
- Aug 2005-July 2010: Ph. D, Indian institute of science, Bengaluru.

RESEARCH INTERESTS:

1. **Metal-organic frameworks (MOFs)**: Metal organic frameworks (MOFs) are crystalline coordination polymers, built from the connectivity of organic linker ligand and metal ions/metal clusters (secondary building units, SBUs). MOFs present unprecedented topological richness because the geometric regularity of high symmetry cluster binding to organic linkers allows topology-directed synthesis. The hybrid nature of MOFs, tunable pore surface, and high dispersion of components, all point at applications of MOFs in heterogeneous catalysis. The catalytic properties of MOFs arise from both metals and linker-based chemical functionality. The unique opportunity with MOFs is their "tunability," i.e., the ability to modulate their properties by modifying the organic linker or metal ion while maintaining the basic topology. Our research efforts are directed in harnessing this unique opportunity and develop versatile class multifunctional catalysts for fine chemical synthesis and biomass conversion.

2. Boron nanomaterials: Bulk boron and its compounds have wide range applications in various fields ranging from superhard materials to biomedicine. Boron exhibits interesting unusual properties mostly originating from its electron

deficiency. Despite its proximity to carbon in the periodic table, boron nanostructures are scarcely studied and chemical properties have not been fully elucidated. The only widely studied boron based nanomaterial is boron nitride. Currently we are engaged in design of new synthetic methodologies to realize only boron containing nanomaterials (from nanoparticles to two dimensional sheets).

RECOGNISTIONS:

- **2016** "Early career research Award" from Department of science and technology, Government of India
- **2015** "DST-INSPIRE Faculty Award" from Department of science and technology, Government of India
- **2011-2013** "Alexander von Humboldt Fellowship" from Alexander von Humboldt foundation, Germany government
- **2010-2011** "Post-doctoral fellowship" from Research Department- Interfacial Systems Chemistry, Ruhr University, Bochum
- **2009-2010** "Best Ph. D thesis award- Prof. S. Soundarajan Medal" from Indian Institute of Science (IISc), Bengaluru**.**
- **2007-08** "Vasudevamurthy-Soundarajan prize" for best seminar during the academic year from Department of Inorganic Physical Chemistry, Indian Institute of Science (IISc), Bengaluru
- **2007-2010** "Senior research fellowship (SRF,)" from Council of Scientific and Industrial Research (CSIR), Government of India.
- **2005-2007** "Junior research fellowship (JRF,)" from Council of Scientific and Industrial Research (CSIR), Government of India."

SELECTED PUBLICATIONS:

1. S.B. Kalidindi, S. Nayak, M.E. Briggs, S. Jansat, A.P. Katsoulidis, G.J. Miller, J.E. Warren, D. Antypov, F. Corà, B. Slater, M.R. Prestly, C. Marti-Gastaldo, M.J. Rosseinsky "Chemical and Structural Stability of Zirconium-based Metal-Organic Frameworks with Large Three-Dimensional Pores by Linker Engineering" Angew. Chem. Int. Ed. 2015, 54, 221–226
2. Oh, H; Kalidindi, S. B.; Um, Y.; Bureekaew, S.; Schmid, R.; Fischer, R. A.; Hirscher, M. "A Novel Cryo-Flexible Covalent Organic Framework for Efficient Hydrogen Isotope Separation by Quantum Sieving" Angew. Chem. Int. Ed. 2013, 52, 13219 –13222
3. Kalidindi, S. B.; Yusenko, K.; Fischer, R. A. "Metallocenes@COF-102: organometallic host–guest chemistry of porous crystalline organic frameworks", Chem. Commun. 2011, 47, 8506-8508.
4. Kalidindi, S. B.; Esken, D.; Fischer, R. A. "B-N chemistry@ZIF-8: dehydrocoupling of dimethylamineborane at room temperature by size confinement effect", Chem. Eur. J. 2011, 17, 6594-6597
5. Kalidindi, S. B.; Jagirdar, B. R. "Highly Monodisperse Colloidal Magnesium Nanoparticles by Room Temperature Digestive Ripening", Inorg. Chem. 2009, 48, 4524.

STUDENTS

PhD students

B. Vasudeva Rao

Project Fellows

K. Sucharita

ACADEMIC PROJECTS:

1. **Design and Development Stable Metal Organic Frameworks with Multiple Functional Sites for Catalysis**

Principal Investigator: Dr. Suresh B. Kalidindi
Funding agency: DST

Metal organic framework (MOF) catalysis deserves exploration basing on its own merits rather than exploring MOFs as potential substituents to conventional catalysts such as zeolites. The project aims at harnessing the superior tunability of MOFs to co-assemble different catalytic units (more than two) in a well-defined way for cooperative/tandem catalysis with the objective of forming high-value added products. The possibility to contain simultaneously antagonistic active sites at the linker, metal site or pore volume makes MOFs apt candidates for tandem catalysis. Here, it is proposed to use well designed MOF catalysts (with at least three active centres) for biomass conversion into value added chemicals. Here all incorporated functional sites are acts as active centres and catalyse at least one step. Overall, the project deals with design, synthesis, characterization and catalytic properties of new generation of complex MOF catalysts that contain at least three functional sites.

Status: On going

2. **Transformative Crystalline Hybrid Porous Materials: Chemical Synthesis and Applications**

Principal Investigator: Dr. Suresh B. Kalidindi
Project fellow: Mr. B. Vasudeva rao
Funding agency: DST-INSPIRE

The present project deals with one of the rapidly developing areas of material chemistry, i. e. metal-organic hybrid frameworks. The ultimate goal of this work is to design and develop MOFs that are functional for practical applications with minimum limitations. These crystalline materials offer potential in the fields of energy, environment and drug delivery thanks to their regular, organized porous structure. For example, proposed Ti-based MOFs have huge potential to act as ideal catalysts for photo splitting of water. However, simply soaking the MOFs in water can cause a change in the structure and alter the MOF enough to destroy its usefulness for a specific purpose. Therefore, significant progress could be made in this area only if stable MOFs have been realized

Status: ongoing

Biological Sciences Department

The Biological Sciences Department was established in 2010 under the guidance of Prof. A. B, Halgeri, Director, PPISR. The department is equipped with facilities for isolation and identification of microbes, plant and microbial secondary metabolites extraction systems, molecular biology facilities for the cloning, recombinant expression, purification and crystallization of key biomolecules. Computational facility with essential packages for crystallographic data analysis, phasing and refinement, model building, *ab initio* modeling, and various other programs are available in the lab. The research activities in the department are supported by grants from agencies such as Department of Biotechnology (DBT), Board for Research In Nuclear Science (BRNS), Vision Group On Science and Technology (VGST) along with in-house funding (PPISR).

Our mission is to advance knowledge of basic biological sciences and apply this understanding in the area of biotechnology. We strive to fulfill our mission every day educating and preparing the next generation of scientists in biological sciences. The Biological Sciences Department offers PhD program in two major research areas; Structural biology and Microbiology. In structural biology our main focus is on the study of proteins having biological and medicinal importance. For example, enzymes involved in purine metabolism, methyltranseferases implicated in antibiotic resistance and structure based modification of T-cell costimulatory molecules to generate lead molecules for autoimmune disorders and cancer. The other group headed by Dr. Ananda K. mainly focuses on antidiabetic compounds from endophytic fungi isolated in medicinal plants. Dr. Ananda K. also initiated some progress in modification of insulin for improving its therapeutic applications in controlling diabetes. All the students in the department are registered for PhD under

Manipal University. Students have to go through rigorous course work and training as part of PhD programme with Manipal University.

Major Areas of Research

1. Structural and functional studies of enzymes involved in purine metabolism.
2. Modification of T-cell costimulatory molecules to generate lead biologics to treat autoimmune disorders and cancer.
3. Bioactive compounds from plant and endophytic fungal association.
4. Lignin degrading enzymes from endophytic fungi.
5. Chemical modification of therapeutic protein for enhancing their half life

Academic Research Highlights

Biological Science department has made significant progress in the last five years. The department has published several papers in national and international journals. Two students have received PhD award and one is submitting her thesis in this year to Manipal University. Protein purification system AKTA start has been added to the list of already existing facilities and we expect more instruments to arrive at the department from the third installment of CISEE grant of VGST, Karnataka.

Structural biology group has determined a total of 15 protein structures from PPISR. These include apo and several complexes of PRTases from pathogenic organisms *Y. pseudotuberculosis*, *F. tularensis* and an antibiotic resistance Methyltransferase from *Sinorhizobium meliloti*. Overall, the group has submitted five structures to Protein Data Bank, an international repository of protein structures. These structures represent the first few protein structures contributed to PDB from PPISR. We have also successfully cloned several T-cell costimulatory molecules and their ligands on the antigen-presenting cells for structural analysis. We have also created mutants of these proteins as potential therapeutic agents against autoimmunity and cancer. One of our collaborative publications is accepted in the journal "*PLOS* Pathogens" and few more manuscripts are under communication.

Microbiology group has isolated a few natural compounds from endophytic fungi with anti-diabetic, anti-cancer as well as antioxidant properties in *in-vitro* studies. These compounds might be the potential candidates for the future alternative drugs for the above diseases. Two students were awarded PhD related to their work in the above research work. The group is also working on laccase enzymes from endophytic fungi and studied effect of radiation on its production. The papers presented in the national conferences got best presentation award to the student working on this. The group is also having research collaboration with NITK Suratkal, MIT, Manipal, Mangalore University and has publications in reputed journals. Currently, focus of our research group is further streamlined towards the enzyme inhibitors related to the diabetes and modification of insulin for the therapeutic applications. The group is making efforts to get more funded projects using this data in future.

Faculty Profiles

Dr. Udupi A. Ramagopal

Ramalingaswami fellow (DBT)
Associate Professor
udupi.ramagopal@poornaprajna.org

BROAD AREAS OF RESEARCH

1. Costimulatory molecules: Biology and therapeutic intervention.
2. Structural study of proteins from enolases superfamily.
3. Structural Studies of Adenine Phosphoribosyltransferases from Pathogenic Bacteria
4. Testing the limits of phasing methodologies using weak anomalous signal

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

1. 2014 – Till date, Associate Professor: 2011 – 2013 Assistant Professor, (Ramalingaswami Fellow - DBT), Poornaprajana Institute of Scientific Research, Bengaluru, India.
2. 2009-20011: Instructor, Albert Einstein College of Medicine (AECOM), USA
3. 2005-2009: Faculty Associate, Albert Einstein College Of Medicine, New York, USA.
4. 2003-2005: Senior Research Associate, Department of Biochemistry, Albert Einstein College Of Medicine, New York, USA.
5. 2001-2003: Visiting Fellow, National Institute of Health, USA.
6. 2001: PhD, Department of Physics, Indian Institute of Science, Bengaluru, India.

RECOGNITIONS:

1. **Ramalingswami fellow, DBT**, India (2011 - current).
2. Best thesis "**Kumari L. A. Meera Award and a Gold Medal**", 2001, **IISc**, India.
3. **Visiting Fellow** (2001 – 2003, NIH, USA).
4. Visiting Faculty**, Albert Einstein College of Medicine, USA**, 2011 – till date.
5. Proposal reviewer: Macromolecular Crystallography, APS, **Argonne National Laboratory, USA**.
6. Served in the "User Executive Committee 2002-2003" of National Synchrotron Light Source, **Brookhaven National Laboratory, USA**.

7. Contributed **~230 protein structures** to World Wide Protein Data Bank (wwPDB).
8. Invited Instructor (2003-2010) at *RapiData*, a comprehensive course offered at **Brookhaven National Laboratory** for budding crystallographers around the world (http://www.bnl.gov/rapidata/).
9. **Referee** for *Acta CrystallographicaSection D,* Biological crystallography.
10. Doctoral Advisory committee **(DAC) member** for two students registered under Manipal University
11. **Scientific Advisor** "Genelon Life Science Ltd.", Yelahanka, Bengaluru

PUBLICATIONS:

In Peer reviewed journals (Overall): **40** (H-index: 22 and I_{10}-index 30).

Representative Publications:

1. **Ramagopal, U. A**., Ramakumar, S., Sahal, D., Chauhan, V. S. **2001**, *De novo* design and characterization of an apolar helical hairpin peptide at atomic resolution: Compaction mediated by weak interactions. **Proc. Nat. Acad. Sci.** (USA) 98(3): 870-874. **JIF** (2011) **= 9.8**
2. **Ramagopal, U. A.,** Dauter, M. and Dauter, Z. **2003**. Phasing on anomalous sulfurs: What is the limit? **Acta Cryst. D59**,1020-1027. **JIF** (2011) **= 7.3.** (Cited ~ 80 times and referred in popular book "Biomolecular crystallography" by Bernhard Rupp).http://www.nsls.bnl.gov/newsroom/publications/newsletters/2003/03-nov.pdf)
3. **Ramagopal**, **U. A*.**, Thirumuruhan, RA., Fedorov, L., Dauter, Z. and Almo, S.C. **2005.** Radiation-induced site-specific damage of mercury derivatives: phasing and implications. **Acta Cryst. D61**, 1289-1298. (***Corresponding author**), **JIF** (2011) **= 2.7**
4. Cao., E, **Ramagopal, U. A.**, Fedorov, A., Fedorov, E., Yan, Q., Lary, J., Cole, J., Nathenson, S. G. and Almo, S. C. **2006.** NTB-A Crystal structure: implications for homophilic interactions and signaling within the SLAM family of receptors.**Immunity**, 25(4), 559-570. **JIF** (2011) **= 21.6**
5. Chattopadyay, K., **Ramagopal, U. A.,** Mukhopadhaya, A., DiLorenzp, T. P., Brenowitz, M., Nathenson, S. G. and Almo, S. C. **2007.** Novel assembly and structural properties of human GITRL: Implications for function. **Proc. Nat. Acad. Sci.** (USA). 104(49), 19452-19457. **JIF** (2011) **= 9.8** http://www.immunity.com/content/article/abstract?uid=PIIS1074761307001835
6. Chattopadyay, K., **Ramagopal, U. A.,** Brenowitz, M., Nathenson, S. G. and Almo, S. C. **2008.** Evolution of GITRL immune function: Murine GITRL exhibits previously unrecognized structural and biochemical properties within the TNF ligand superfamily. **Proc. Nat. Acad. Sci.** (USA). 105(2), 635-640. **JIF** (2011) **= 9.8.** : News: http://stke.sciencemag.org/cgi/content/abstract/sigtrans;1/3/ec30
7. Samanta, D., **Ramagopal, U. A**., Nathenson, S. G. and Almo, S. C. **2012**, Structure of Nectin-2 reveals determinants of homophilic and heterophilic interactions that control cell-cell adhesion. **Proc. Nat. Acad. Sci.** (USA), 109(37):14836-40, **JIF** (2011) **= 9.8.**
8. Rubinstein, R., **Ramagopal, U. A**., Nathenson, S. G., Almo, S. C. and Fiser, A. **2013,** Functional Classification of Immune Regulatory Proteins. **Structure (Cell press),**

21(5), 707-717. **JIF** (2011) **= 6.4. Comment at : http://www.sciencedirect.com/science/article/pii/S0969212613001251**

9. **Ramagopal, U. A**., Dulyaninova, N. G., Varney K. M., Wilder, P. T., Nallamsetty, S., Brenowitz, M., Weber D. J., Almo S. C. and Bresnick, A. R. **2013,** Structure of the S100A4/myosin-IIA complex. **BMC Struct. Biol.,**13(1), 31. [Epub ahead of print], **JIF** (2011) **= 2.5.**
10. Bhowmick, T., Ghosh, S., **Ramagopal, U. A**., Day, D., Ramakumar, S., Nagaraja, S. 2014, Structure based inhibition provides an insight into the HU mediated regulation in Mycobacterium tuberculosis. **Nature Communications**, 5, 4124. JIF (2013) =10.7

RESEARCH HIGHLIGHTS:

A biological cell is a highly complex and organized soup of proteins, DNA, RNA, lipids and many other complex molecules that work in synergy. Although, the information necessary for the energy metabolism, defense, sensing the external world, and all other essential processes for the survival are hidden inside the genome of the cell, the real workhorse molecules are the proteins. These proteins can synthesize highly complex molecules essential for everyday life, act as framework for the cell shape and integrity, sense external molecules and also the possible threat from the outside world and so on. Over the course of evolution, nature has learnt all the tricks to create these nano-machines (proteins and their complexes), which are polymers made of just twenty different amino acids. We are interested in understanding these magical-machines, one at a time or when they are talking to each other, using biophysical and biochemical techniques. Since, the visible light has its own limitation to see such objects at atomic details, we use X-rays (X-ray diffraction from ordered 3D-array of these molecules, called crystals) to visualize such molecules. For example, we are interested in structure based functional characterization of key bacterial enzymes responsible for synthesis of essential small molecules for their survival. We are also interested in the molecules on the surface of the immune cells, so called “immune receptors” that recognize the external enemy like bacteria or our own cancer cells and play a critical role in the clearance of such threats.

RESEARCH GROUP:

Research Associate:

1. Dr. Raghurama P. Hegde

Graduate Students:

2. Mrs. Pavithra G. C.
3. Ms. Swetha Lankipalli.
4. Mr. Shankar Kundapur

SPONSORED PROJECTS:

1. Grant titled “Design of modified B7-1 (CD-80) and B7-2(CD86) molecules to create potential reagents for cancer and auto-immune disorders”, Vision Group on Science and Technology (VGST), Karnataka.
2. Ramalingaswami Fellowship titled “Costimulatory molecules: Biology and therapeutic intervention”, Department of Biotechnology (DBT), New Delhi, India.

Current Projects:

3. **Co-stimulatory molecules: Biology and Therapeutics Interventions**

   Primary Investigator: Dr. Ramagopal U. A.

   Research Student: Shankar Kundapur

   Immune checkpoint receptors play an instrumental part in maintaining the balance between cancer and autoimmune disorders. Some of these receptors boosts the immune response and others retards the immune response. It is of importance to note that tumor cells express some of these immune checkpoint receptors to manipulate and subvert the immune response away from it. This has been observed in a wide range of cancer types. Currently, antibodies to block these immune checkpoint receptors have been in use. However, cost and immune adverse effects are major limiting factors for successful use of these antibodies. We propose to structurally modify some of these checkpoint receptors to shut down the immune pathways exploited by tumor cells. Some of the pathways we are exploring are PD-1, TIM-3 and LAG3 pathways

4. **Structural Studies of Adenine Phosphoribosyltransferases from Pathogenic Bacteria**

   Primary Investigator: Dr. Ramagopal U. A.

   Research Student: Mrs. Pavithra G. C.

   Adenine phosphoribosyltransferase (APRT), a key enzyme in purine salvage pathway, catalyzes a reaction between adenine and phosphoribosyl pyrophosphate to produce adenosine monophosphate (AMP) and pyrophosphate. Pathogenic bacteria such as *Y. pseudotuberculosis, M. pneumonia, H pylori* and *F. tularensis* that are known to cause pseudotuberculosis, gastritis/duodenal cancer and tularemia respectively depend solely on the salvage pathway for their survival. Hence, understanding the structure and function of these APRTs appears to be the key step towards the design of effective drugs to combat diseases caused by these organisms. Towards this goal, we have determined around eight structure of APRT's, including complex structures with substrates and product (AMP).

5. **Testing the limits of macromolecular crystallographic phasing**

   Primary Investigator: Dr. Ramagopal U. A.

   Research Associate: Dr. Raghurama P. Hegde

   Single wavelength anomalous dispersion (SAD) utilizing anomalous signal from native sulfurs or atoms with Z≤ 20 generally needs highly redundant data collected using softer X-rays. Here we present real-life application on two proteins, where anomalous signal from serendipitously acquired surface bound calcium atoms with data redundancy as low as 10 was exploited to drive the *de novo* structure solution. In both the cases, the calcium atoms were picked up from the crystallization condition and the data collection strategy was not optimized for exploiting the anomalous signal from these scatterers. The X-ray data were collected around 0.98Å in one case and at 1.74Å in the other. Similarly, using a test case, we show that the data collected at ~1.0Å wavelength, where the f" value for sulfur is 0.28e, is sufficient to solve the structure using intrinsic sulfur atoms from a strongly diffracting crystal. Interestingly, it was also observed that SHELXD was able to find substructure solution from a high-exposure data set alone with a completeness of 70% for low-resolution reflections till 3.5Å and redundancy as low as 6.0. Considering the fact

that many crystallization conditions contain anomalous scatterers such as Cl, Ca, Mn etc., it appears that the data from well diffracting crystals should be processed with anomalous pairs kept separate, which could prove useful in either solving the structure *de novo* or in assigning surface bound atoms.

6. **Modification of TIGIT as potential immunotherapeutic agent against cancer and autoimmunity**
   Primary Investigator: Dr. Ramagopal U. A.
   Research Associate: Dr. Raghurama P. Hegde
   T-cell immunoreceptor with Immunoglobulin and ITIM domains (TIGIT) is a recently identified co-stimulatory molecule expressed on T and NK cells that suppresses activation of T-cells and NK cells upon interaction with either of its two ligands, nectin-2 or PVR. Studies have shown that it could play a role in cancer and autoimmunity. The aim of this project is to modify some of the key residues that affect the interaction of TIGIT with nectin-2, to modulate the binding and use this as a potential immunotherapeutic agent against cancer and autoimmunity.
7. **Design of modified B7-1 (CD-80) and B7-2(CD86) molecules to create potential reagents for cancer and auto-immune disorders.**
   Primary Investigator: Dr. Ramagopal U. A.
   Research Student: Ms. Swetha. L.
   In this project we would like to modify the B7-1 and B7-2 ligands binding surfaces to fine-tune their recognition and avidity towards either CTLA-4 or towards CD28. Efficacy of the modified B7 molecules to bind to their cognate receptors will be assessed using biophysical methods including X-ray crystallography. The results are expected to provide lead molecules that are effective against auto-immune disorder or cancer.

EVENTS AND ACHIEVEMENTS:

- Dr. Ramagopal was invited to collect macromolecular X-ray diffraction data at BM14 beamline of the European Synchrotron Radiation Facility (ESRF), Grenoble, France, from 26th November 2015 to 6th December 2015.
- Structural Biology lab determined structure of around THIRTEEN protein/complex structures from PPISR and four of them have been submitted to Protein Data.
- Dr. Ramagopal visited Department of Biochemistry, Albert Einstein College of Medicine, New York on a collaborative project with Prof. Steven C. Almo.
- Dr. Udupi Ramagopal delivered an invited talk " Macromolecular crystallography and its impact on biology" at the VGST sponsored Two Day Lecture series on 'Celebrating the International year of Crystallography (IYCR-2014)'- looking to the future, learning from the Past, at KLE Society's B. V. Bhoomaraddi college of Engineering and Technology, Hubballi on 13 March 2015.
- Dr. Ramagopal attended the Ramalingaswami Fellow's conclave held at Regional Centre for Biotechnology, Faridabad, New Delhi from 18-20th December 2015.
- Dr. Raghurama P Hegde delivered an invited talk "Efforts towards structure determination of therapeutic proteins", on 27 Jan 2015, at the Department of Biotechnology, Sir M.Visvesvaraya Institute of Technology, Bengaluru as part of a weeklong student development program at the Department.

- Ms. Swetha attended the 17th Indo-US Cytometry workshop on 'Applications of Laser flow cytometry in Biomedical research'from 14th -18th march, 2016 organised by Indian institute of science, Bengaluru in collaboration with NCBS, Bengaluru and International Society for the Advancement of Cytometry (ISAC), USA.
- Ms. Swetha presented her second and third six monthly DAC progress report
- Ms. Pavithra presented her fifth and sixth DAC progress report on 13th October 2015 and 14th April 2016 respectively.
- Dr. Raghurama Hegde was the judge for the Biology exhibits as part of the Science and Arts Exhibition held at Poornaprajna Education Centre, Sadashivnagar on 19th September, 2015. The topic of the exhibition in biology was nervous system, brain and neurons.
- Ms. Pavithra presented poster titled "***Functional insights from the structures of Purine phosphoribosyltransferases of pathogenic bacteria***" at "The 13thconference of the Asian Crystallographic Association" on 5-8 December 2015 held at Science city, Kolkata, India.
- Ms. Pavithra also presented her poster titled "***Structural studies of Adenine phosphoribosyltransferases of pathogenic bacteria***" at "The Research Colloquium" on 4th April 2016 held at Manipal University, Manipal.
- Ms. Swetha attended "MCB75: from Molecules to Organisms" organised on the eve of completion of 75 years of Department of Microbiology & Cell biology, Indian Institute of Science from December12-14, 2015.
- Ms. Swetha attended "100 years of Chemical Bond" organised on the eve of completion of 100 years of the concept of chemical bond by G.N. Lewis, at JNCASR, Bengaluru on 29.1.16.

Dr. Ananda K.

Asst. Professor

Email: ananda@poornaprajna.org

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

2011-Present: Assistant Professor, PPISR, Bengaluru, India

2010-2011: Faculty Fellow, PPISR, Bengaluru, India

2004-2010: Post Doctoral Fellow, Albert Einstein College of Medicine, NY, USA

2004-2004: Lecturer, P A College of Engineering, Mangalore, India

2003-2004: Project Associate, IWST, Bengaluru, India

1999-2003: Administrative Supervisor, KSRTC, Govt. of Karnataka, India

1996-2001: PhD, Mangalore University, Mangalore, India.

1995-1996: Project Assistant, College of Fisheries, Mangalore, India

1993-1995: MSc, Biosciences, Mangalore University, Mangalore, India

BROAD AREAS OF INTEREST

1. **Anti-diabetic compounds of endophytic fungi from Medicinal plants used for the treatment of diabetes:** Diabetes is one of major prevailing diseases around the world with high risks of growth in India. Preventing diabetes is the best option at present situation. If at all one gets a diabetes then maintaining normal blood sugar level in the blood is a major task throughout the life. There are various types of medications available for controlling diabetes but each one has one or the other side effects. Natural extracts from medicinal plants or endophytic fungi can be an alternative to avoid such side effects. This research group focusing on isolating anti-diabetic compounds from the endophytic fungi which are living inside the medicinal plants and study their applications in treating diabetes

2. **Effect of radiation on endophytic fungi producing ligninase enzyme and antidiabetic inhibitors:**Radiation exposure can cause different effects on organisms in the environment. There are cases where plants yield was increased by exposing them to different types of radiation. Similarly, if we expose endophytic fungi (which are already known for producing industrially useful enzymes and secondary metabolites for pharmaceutical applications)

for various types of radiation that might influence in increased production of ligninase or secondary metabolites by the fungi. As the ligninase is known for degradation of phenolic compounds, can be applied in degradation of textile and other industrial wastes. Secondary metabolites may be useful as inhibitors of enzymes involved in diabetes control.

3. **Modification of Insulin molecule to improve its half-life and other therapeutic properties**: Controlling sugar in a diabetic patient has become a major challenge due to increased diagnosis of diabetes cases in recent years. Type 2 diabetes is a major type of diabetes and main causes are insulin resistance, reduced secretion and others. The purpose of this research is to modify the insulin using conjugation chemistry using protein or non-protein molecules to increase the half life as well as its pharmacodynamics properties *in-vitro* and/or *in-vivo* models

MEMBERSHIP OF PROFESSIONAL BODIES

Life Member of Mycological Society of India
Life member of Association of Microbiologist of India

RECENT PUBLICATIONS FROM THE LIST OF 32:

1.Pavithra N., Sathish L., Suneel Kumar A., Venkatarathanamma, V., Pushpalatha H., Bhanuprakash Reddy, G., **Ananda K**. (2014): *In-vitro* Studies on α-Amylase, α-Glucosidase and Aldose Reductase Inhibitors found in Endophytic Fungi Isolated from *Ocimum sanctum, Current Enzyme Inhibitor 10(2)129-136.*

2.N. Pavithra, L. Sathish, Nagasai, Babu, V. Venkatarathanamma, H. Pushpalatha, G. Bhanuprakash Reddy**, K. Ananda** (2014) Evaluation of α-Amylase, α-Glucosidase and Aldose Reductase inhibitors in ethyl acetate extracts of endophytic fungi isolated from anti-diabetic medicinal plants. *Int J Pharm Sci Res. 5 (12) 5334-5341.*

3.Shubhalaxmi, Pathak L**, Ananda K**, Bhat KS. Synthesis of focused library of novel aryloxyacids and pyrazoline derivatives: Molecular docking studies and antimicrobial investigation. Cogent Chemistry. 2016 Jan 14(accepted):1141388.

4.Shubhalaxmi NA, Manjunatha BS, **Ananda K**, SubrahmanyaBhat K. Pyrimidinethione derivatives with tosyl substitution: Synthesis, and antimicrobial property investigation. *J. Appl. Pharm. Sci.,* 2016; 6(xx), (xxxx) (in press).

5.Hebbar RS, Isloor AM, Ananda K, Ismail AF. Fabrication of polydopamine functionalized halloysite nanotube/polyetherimide membranes for heavy metal removal. Journal of Materials Chemistry A. 2016;4(3):764-74

6.N Harikrishna, Arun M Isloor, **K Ananda**, Abdulrahman Obaid, Hoong-Kun Fun (2015). 1, 3, 4-Trisubstituted pyrazole bearing a 4-(chromen-2-one) thiazole: synthesis, characterization and its biological studies. *RSC Advances*, *5*(54), 43648-43659.

7.Garudachari B, Isloor AM, Satyanaraya MN, **Ananda K**, Fun H-K. (2014) Synthesis, characterization and antimicrobial studies of some new trifluoromethyl

quinoline-3-carbohydrazide and 1,3,4-oxadiazoles. *RSC Advances.* 2014;4(58):30864-30875

8.Sathish, L., Pavithra, N. and **Ananda K**. (2014) Evaluation of antimicrobial activity of secondary metabolites and enzyme production from endophytic fungi isolated from *Eucalyptus citriodora. Journal of Pharmacy Research* 8(3); 269-276.

9.Garudachari B, Isloor AM, Satyanarayana MN, Fun HK, Pavithra N and **Ananda K.** (2013)Design and regioselective synthesis of trifluoromethylquinolone derivatives as potent antimicrobial agents. *European Journal of Medicinal Chemistry 68;* 422-432.

TRAINING OF STUDENTS:

PhD guided	: 02
MSc Projects guided	: 03
BSc Project guided	: 06
BSc Inspire students	: 03
PhD students working	: 03

PhD STUDENTS:

Ms. Kavitha K N

Mr. Kiran M P

Ms. Shrilakshmi S

PROJECTS

Completed Projects:

1. **Antimicrobial and anti oxidants of endophytic fungi from Medicinal plants**
   Principal Investigator: Dr.Ananda K. ; Research Fellow: Sathish L
2. **Anti-diabetic compounds of endophytic fungi from medicinal plants used for the treatment of diabetes**.
   Principal Investigator: Dr.Ananda K. ; Research Fellow: Pavithra N
3. **Anticancer metabolites from endophytes of medicinal plants**
   Principal Investigator: Dr. Ananda K

Ongoing Projects:

1. **Effect of electron beam radiation on endophytic fungi producing ligninase enzyme**

PI: Dr.Ananda, K.; Research Scholar: Ms.Kavitha KN

Endophytic fungi isolated from*Simarouba glauca*were tested for the ligninase enzymes production. Endophytic fungi positive for ligninase are exposed to electron beam radiation and subcultured in to a new media. The effect of various doses of electron beam radiation was analysed with respect to the production of ligninase enzymes. The dye degradation rate was also analysed for all the fungal cultures exposed to radiation. The changes in rate of dye degradation found after irradiation observed in some of the cultures. The cultures were grown for several generations to check the consistence in enzyme production. The dose of radiation at which fungi produces highest amount of enzyme will be used for further studies.

2. **Alpha glucosidase enzyme inhibitors from *Simarouba glauca* and from its endophytic fungi**

   PI: Dr.Ananda K, Reseach Scholar: Mr.Kiran M P

   Alpha glucosidase enzymes are involved in degradation of disaccharides into monosaccharides and these mono saccharides are absorbed into the blood stream in the small intestine. The starchy food taken into the body immediately digested and blood glucose level will increase in the body. The enzyme insulin will be secreted into blood stream and all the excess of glucose in the blood will be stored as glycogen under normal condition. In case of diabetic patient the glucose taken into the blood will be stored immediately due to improper activity of insulin or other receptors. Hence, the diabetic patients are not encouraged to eat starchy food. To avoid this elevation in blood glucose level in the blood the present study focused on searching for a natural alpha glucosidase inhibitor.

3. **Site specific modification of insulin for increasing its half-life and pharmacological properties**

   PI: Dr.Ananda K. ; Research Scholar : Ms. Shrilakshmi S

   Insulin protein has chain A and Chain B in the active form. The binding affinities and sites of biological degradation of insulin will be analysed by molecular docking studies. The modification of amino acids either by mutating an less important amino acid with the easily modifiable one or modification of a specific amino acid by a polyethylene glycol molecule to reduce rate of insulin degradation. There will be few different types of molecules will be prepared by such modifications and each one will be analysed for their biochemical properties and later tested for in-vitro models.

RESEARCH COLLABORATION

1. Dr. Arun M Isloor, NITK, Surathkal collaboration for the antimicrobial assay of synthetic compounds
2. Genelon Institute of Lifesciences, Bengaluru made a MOU for mutual collaborative research and Dr.Ananda K is a member of scientific advisor committee.

GOVT. SPONSORED PROJECT:

Received research grant for the project titled “Effect of electron beam radiation on endophytic fungi producing ligninase enzyme” for three years from BRNS, DAE, Govt. of India

Theoretical Sciences Department

Introduction

The Department was established in 2005 with the induction of Dr. Sujit Sarkar in 2005, and formally recognized as such during the renewal of PPISR's recognition by Manipal University (MU) in 2010, along with the Materials Science and Biological Sciences Departments. Per the suggestion of Prof. K. J. Rao of AMEF and the Director, Prof. A. B. Halgeri, the scope of the Divison was enlarged to include philosophical studies, apart from mainstream physics research being pursued by the existing faculty members, Drs. Sujit Sarkar and R. Srikanth. Dr.Manisha Kulkarni (specializing in number theory) was a faculty member during 2007--2011 and Dr. S. G. Bhargavi (specializing in gamma-ray astronomy) was an honorary faculty member during 2012--2013.

Mr. Omkar and Mr. Arvinda, who registered for PhD in Sep 2011 and Feb 2011 with MU, respectively, with Dr. R. Srikanth. Mr. G. N. Chandan and Mr. Nepal Banerjee has joined with Dr. Sujit Sarkar, are the four students with the Department.

Dr. Omkar obtained his PhD in June 2015 under the guidance of Dr. Srikanth

Broad areas of research:

1. Quantum physics of many-body systems and condensed matter physics
2. Non-equilibrium statistical physics
3. Quantum information processing & cryptography; foundations of quantum mechanics
4. Metamathematics and computability theory in physics

Specific problems pursued by members include: (1) Quantum criticality of geometric phase in coupled optical cavity arrays under linear quench; (2) Quantum phase transition of light in coupled optical cavity arrays: A renormalization group study; (3) Solitons and spin transport in an antiferromagnetic spin chain; (4) Counterfactual quantum certificate authorization; (5) Nonclassicality of signaling correlations; (5) Characterizing quantum noise using quantum error correcting codes; (6) Biologically inspired category theory and process calculus approach to software design with applications to cryptography and data management.

The department has published more than 80 publications in reputed international journals since its inception and produced one PhD. Also currently two sponsored projects are executed in the department.

Faculty Profiles

Dr. Sujit Sarkar

Assistant Professor

E-mail:sujit.tifr@gmail.com

BRIEF CV:

- 2005-Present: Asst. Professor, PPISR, Bengaluru, India
- 2002-2005: Post-Doc,Condensed Matter Physics Dept., Weizmann Institute of Science
- 2000-2002: Guest Scientist, Max-Planck Institute for the Physicsof Complex System.
- 1999-2000: Post-Doc, Phys.Dept of Bar-Ilan University, Israel
- 1997-1999: Post-Doc, Phys. Dept of IISc, Bengaluru.
- 1992-1997: Ph.D, Saha Institute of Nuclear Physics.
- 1990-1991: Post-M.Sc Course
- 1990: M.Sc. Pure Physics, Calcutta University, India

RESEARCH INTERESTS:

1. Topological Quantum Phase Transition in Light-Matter Physics

In general, topologically non-trivial phase can not adiabatically deform into a topologically trivial one and it is robust under perturbation and/or disorder unless the bulk gap closes. It has recently discovered that the topological phases are enriched by the general symmetries of time reversal and charge conjugation. These non-spatial symmetries can persists even inthe presence of disorder and perturbation. For instance, the non-magnetic disorder preserve the time reversal symmetry and thus a non-trivial topological phase accompanied by the time reversal symmetry is robust against non-magnetic disorder. Quantum spin Hall effect and topological insulator support such topological phases protected by the time reversal symmetry operation. In a similar manner, charge conjugation specific to superconductivity, make it possible to realize a novel topological state of matter, i.e., the topological superconductor.

Topological phases are enriched by those general non-spatial symmetries.

The research project was proposed based on these topological and symmetry properties of matter. In recent years, the physics of light-matter system consider as an extended branch of quantum condensed matter system. To the best of our knowledge, the topological quantum phase of light-matter system has not explored properly, not even in the early stage of this subject.

2. **Quantum Simulation and Quantum Engineering in Condensed Matter Many Body System.**

Quantum Engineering seem a justified and necessary name for the fast-expanding field. Its subject covers the theory, design, fabrication and application of solid-state-based structure which can maintain quantum coherence in a controlled way. In a nutshell, it is about how to build devices out of solid-state qubits and how they can be used. One of the often uses the term ”Mesoscopic Physics” especially with respect to solid-state devices, meaning objects on an intermediate scale between truly microscopic (single atom or small molecule) and truly macroscopic. Despite their comparatively large size (~ 10 11 −10 12), mesoscopic systems maintain enough quantum coherence so that quantum effects really matter. The experimental techniques and theoretical understanding developed in these fields strongly contributed to the development of quantum engineering. In my research, I mainly concentrate on two directions in quantum engineering using as building blocks superconducting quantum dots. These two kind of two devices are well understood from the theoretical point of view and are being successfully fabricated and investigated by the experimentalists using the rich tool set of solid-state physics.

RECOGNISTIONS:

- “Associateship Position” from S. N. Bose National Centre for Basic Sciences for coming three years.
- “DAAD Fellow” Germany, Karlshrue Institute of Technology, Germany.

PUBLICATIONS 2015-16:

(1). Quantum Simulation of Dirac Fermion Mode, Majorana Fermion Mode and Majorana-Weyl Fermion Mode in Cavity QED Lattice.
Sujit Sarkar , Euro Physics Letters, 110, 64003 (2015). (Refereed)
(2). Existence of Majorana Fermion Mode and Dirac Equation in
Cavity QED Lattice. Sujit Sarkar, Physica B 475, 48 (2015).
(3). A Renormalization Group Study in Helical Spin Liquid: Physicsof Majorana Fermion. Sujit Sarkar, (Phys. Rev. B, under appealstage, arXiv: 1506.06552).
(4). Topological Quantum Phase Transition of Light. Chandan G N, Nepal Banerjee, Sujit Sarkar (Journal of Physical Society of Japan, 85, 014004 (2016).

STUDENTS

PhD student

1. Nepal Banerjee

NATIONAL AND INTERNATIONAL COLLABORATORS

1. Dr. Manoranjan Kumar, S. N. Bose National Centre for Basic Sciences, India.

2. Prof. Dr. Igor Gornyi and his group, Karlshure Institute of Technology, Germany.

RESEARCH:

SPONSORED PROJECTS:

Title: “Geometric Phase and Quantum Phase Transition in Quantum Many Body System” sponsored by Dept. of Science and Technology (Govt. of India) (SR/S2-LOP-007) 2012.

Dr. R. Srikanth

Assistant Professor

E-mail:srik@poornaprajna.org

BRIEF CV:

- 2008-Present: Asst. Professor, PPISR, Bengaluru, India
- 2006-2008: Faculty Fellow, Poornaprajna Institute of Scientific Research, Bengaluru
- 2003-2006: Research Associate, Raman Research Institute, Bengaluru
- 2001-2003: Research Associate, Center for Theoretical Studies, IISc, Bengaluru
- 1999-2001: Postdoc, Indian Institute of Astrophysics, Bengaluru
- 1999: PhD Physics Dept., IISc, Bengaluru

RESEARCH INTERESTS:

1. Foundations of quantum mechanics

Various issues being explored include how extending quantum mechanics entails extending special relativity, the study of nonclassicality of spatial correlations as non-vanishing signal deficit between the communication cost and operational signal, the status of orthogonal-state-based cryptography in quantum mechanics and local post-quantum theories, and most recently, the nonclassicality (uncertainty, contextuality, no-cloning) of single I.e, monopartite systems.

2. Quantum cryptography

Research has covered quantum secret sharing in a simplified hierarchical dynamic protocol with Added Features, which would be suitable in a quantum network. We have explored various aspects of counterfactual quantum communication including creating cat states counterfactually, and a cryptographic application to quantum certificate authorization. The area of secure Quantum Communication with Orthogonal States, which originates from the Goldenberg-Vaidman protocol, has been studied in multipartite quantum systems and in postquantum theories.

3. Quantum information theory

We have explored the characterization of Unruh Channel in the context of Open Quantum Systems, bipartite separability and non-local quantum operations on

graphs, the two-qubit amplitude damping channel: characterization using quantum stabilizer codes, counterfactual distribution of cat states, a quantum information theoretic analysis of three flavor neutrino oscillations, and characterization of quantum dynamics using quantum error correction.

4. **Philosophy of science**

   We our research has focused on the concept of free will as an infinite meta-theoretic recursion, beginning with an attempt to relate undecidability of Gödel, Tarski's undefinability and Turing uncomputability with the conundrum that is free will.

RECOGNISTIONS/AWARDS/MEMBERSHIP:

- DST-sponsored project (Rs. 12 lakhs) "Entanglement, nonlocality and superluminal signaling in deterministic and indeterministic extensions of quantum mechanics" (2013--2016; SR/S2/LOP-02/2012)
- Editor (Quanta, quanta.ws)
- Reviewer (Phys Rev A, Quantum Information Processing, Physica Scripta, Int. J. Theoretical Physics, Quanta, etc.)
- Organizer / co-organizer of
  - International symposium titled Science Meets Oriental Philosophy 2015 (Dec 8, 2015) held at PPISR.
  - Nalanda Dialogs (2009, 2010, 2012): (nalanda-dialogforum.org)
- Invitations to adjudicate in science competitions, and as thesis examiner / reviewer

STUDENTS

PhD students

1. Aravinda S.
2. Sowmya S. M. (jointly with Prof U. Paniveni)
3. Rajni Gangadhar (jointly with Prof U. Paniveni)

Project Fellows

4. Shesha Gopal
5. Avinash Bhargav.

NATIONAL AND INTERNATIONAL COLLABORATORS

1. Prof Dipankar Home, Bose Institute, Kolkata
2. Prof. Anirban Pathak, JIIT, Noida, India
3. Prof Subhashish Banerjee, IIT-Jodhpur
4. Prof. Sisir Roy, NIAS, IISc, Bengaluru
5. Prof. Debajyoti Gangopadhyay, Annada College, Hazaribag

RESEARCH

SPONSORED PROJECTS:

1. **Dialog across traditions: modern science and ancient insights on reality**

   (Sponsored by: ***ICPR, Delhi and CUTS, Sarnath****)*

Principal Investigator: Dr. R. Srikanth
Co-Investigator: Prof. Sisir Roy and Prof Debajyoti Gangopadhyay
Starting Date: June 1, 2016
A proposal for a 3-year project is being first started by means of a national conference to be held in Oct 25-27, 2016, which aims to bring together scientists in the physics, neuroscience streams with Oriental philosophers and logicians with traditional training.
Status: Ongoing

2. **Entanglement, nonlocality and superluminal signaling in deterministic and indeterministic extensions of quantum mechanics**
*(Sponsored by: DST-SERB**, India**)*
Principal Investigator: Dr. R. Srikanth
Research Fellows: Dr. S. Omkar (completed July 2015) and Mr. A. Animesh (completed Feb 2016)

We studied the relationship between quantum nonlocality and relativity in deterministic and indeterministic extensions of quantum mechanics appropriate for a new generation of Bell-type experiments, some of them involving relativistic measurement configurations. In one approach, quantum nonlocality is replaced by superluminal locality defining a preferred reference frame. This model will be applied to nonlocal-realist (Bohm-like) interpretations and to spontaneous collapse theories like of the Ghirardi-Rimini-Weber type in quantum mechanics. In another approach, quantum nonlocality is treated as an indeterministic and possibly signaling influence subject only to the condition of having no non-trivial implications for quantum computation. By design these extensions agree with standard quantum theory for existing experiments, but may differ for the above newer ones. They offer testable possibilities to gain new insights into the mathematical structure of quantum theory, and can potentially shed light on the interplay between physical space and information as fundamental resources.
Status: Completed

ACADEMIC PROJECTS:

3. **On the origin of nonclassicality of monopartite systems.**
Principal Investigator: Dr. R. Srikanth
Co-invetigator: Prof Anirban Pathak
Project fellow: Mr. S. Aravinda
Investigating the foundational basis underpinning nonclassicality in a single (i.e., monopartite), finite-dimensional system in the convex framework, we show that many significant nonclassical features can be derived from two basic ways in which system properties lack peaceful coexistence: (a) Pairwise incongruence of observables, realized
geometrically as the non-simpliciality of the state space; (b) a generalized intransitivity of congruence. Requirement (a) suffices to derive a host of nonclassical features, among them, multiple pure-state decomposability,

non-comeasurability, measurement disturbance, no-cloning, unconditional cryptographic security as well as (with minor provisos) uncertainty, preparation contextuality and the impossibility of certain coherent operations such as the universal inverter. The major feature not covered is Kochen-Specker contextuality, which is shown to arise only when requirement (b) is included, and which can serve as a basis for a kind of device-independent cryptography.
Status: Ongoing

4. Extendingquantum mechanics entails extending special relativity

PhD supervisor: Dr. R. Srikanth
Research Student: Mr. S. Aravinda

The complementarity between signaling and randomness in any communicated resource that can simulate singlet statistics is generalized by relaxing the assumption of free will in the choice of measurement settings. We show how to construct an ontological extension for quantum mechanics (QM) through the oblivious embedding of a sound simulation protocol in a Newtonian spacetime. Minkowski or other intermediate spacetimes are ruled out as the locus of the embedding by virtue of hidden influence inequalities. The complementarity transferred from a simulation to the extension unifies a number of results about quantum nonlocality, and implies that special relativity (SR) has a different significance for the ontological model and for the operational theory it reproduces. Only the latter, being experimentally accessible, is required to be Lorentz covariant. There may be certain Lorentz non-covariant elements at the ontological level, but they will be inaccessible at the operational level in a valid extension. Certain arguments against the extendability of QM, due to Conway and Kochen (2009) and Colbeck and Renner (2012), are attributed to their assumption that the spacetime at the ontological level has Minkowski causal structure.
Status: Completed, published

5. Quantum code for quantum error characterization

Principal Investigator: Dr. R. Srikanth
Co-investigators: Dr Subhashish Banerjee,
Project student: (now) Dr S. Omkar

A protocol based on quantum error correction based characterization of quantum dynamics (QECCD) is developed for quantum process tomography on a two-qubit system interacting dissipatively with a vacuum bath. The method uses a 5-qubit quantum error correcting code that corrects arbitrary errors on the first two qubits, and also saturates the quantum Hamming bound. The dissipative interaction with a vacuum bath allows for both correlated and independent noise on the two-qubit system. We study the dependence of the degree of the correlation of the noise on evolution time and inter-qubit separation
Status: Work completed; published.

6. Exploring the role of Leggett-Garg inequality in quantum cryptography

Principal Investigator: Dr. R. Srikanth
Co-investigators: Prof Dipankar Home,

Project student: (now) Dr Akshata Shenoy and Mr S. Aravinda

An earlier unexplored application of the temporal version of the Bell-type inequality is shown in the cryptographic context by using an appropriate form of the Leggett-Garg inequality (LGI) to demonstrate security against eavesdropping in a quantum key distribution (QKD) scheme. While the key generation is done by the usual Bennett-Brassard 1984 (BB84) method, security check against the specific device attack considered here is provided by testing for the violation of the particular form of LGI used that is invoked

Status: In progress

RESEARCH HIGHLIGHTS

A. Published papers

1. Subhashish Banerjee, Ashutosh Kumar Alok, R. Srikanth and Beatrix C. Hiesmayr., Toward secure communication using intra-particle entanglement. **European Physical Journal**, C,75: 487,2015.
2. Hanaan Hashim and R. Srikanth., A Simplified Hierarchical Dynamic Quantum Secret Sharing Protocol with Added Features. **INDECS** 13: 354,2015.
3. Sandeep Mishra, Chitra Shukla, Anirban Pathak, R. Srikanth, Complementarity between signalling and local indeterminacy in quantum nonlocal correlations Anu Venugopalan. **Int. J. Theor. Phys**. 54: 3143, 2015.
4. S. Aravinda and R. Srikanth, Complemetarity between signalling and local indeterminacy in quantum nonlocal corrections, **Quantum Information & Computation**,15, 0308-0315, 2015.
5. Extending quantum mechanics entails extending special relativity S. Aravinda and R. Srikanth, **J. Phys. A**: Math. Theor. 49, 205302 (2016). arXiv:1506.03058
6. The Unruh effect interpreted as a quantum noise channel S. Omkar, Subhashish Banerjee, R. Srikanth, Ashutosh Kumar Alok, **Quantum Information & Computation** (QIC) 2016, (accepted) ArXiv:1408.1477.
7. Counterfactual distribution of Schrödinger cat states, Akshata Shenoy-Hejamadi and R. Srikanth, **Phys. Rev. A** 92, 062308 (2015).
8. Quantum code for quantum error characterization, S. Omkar, R. Srikanth, and Subhashish Banerjee, **Phys. Rev. A,** 91, 052309 (2015).
9. Toward secure communication using intra-particle entanglement. S. Adhikari, D. Home, A. S. Majumdar, A. K. Pan, Akshata Shenoy H. and R. Srikanth. **Quantum Info. Processing** 14, 1451 (2015).
10. The operator sum-difference representation for quantum maps: application to the two-qubit amplitude damping channel, S. Omkar, R. Srikanth, Subhashish Banerjee, **Quantum Information Processing** 14, 2255 (2015).

B. Papers presented in Conferences

S. Aravinda gave a poster Presentation on his research work titled "*Orthogonal-state based cryptography in postquantum theories*" International Conference on Quantum

Foundations 2015, National Institute of Technology, Patna, November 30 -- December 4, 2015

Review meetings:

1. **PhD Defence VIVA of students and award of PhD degree**

   PhD Defence VIVA of two students; Akshata Shenoy (IISc, with Prof. T. Srinivas) and S. Omkar were conducted on during Jan and July, 2015 in ECE Dept and in the auditorium of PPISR main campus. Defence viva of Dr Akshata was conducted on 16-1-2015. External examiner was Dr. Archan Majumdar, SNBNCBS, Kolkata.

   Dr. Ravi Shankar C, examined Dr. Omkar's thesis and came for his PhD defence on 9-6-2015. The students gave presentation on their entire Ph.D. work systematically. Examiners asked several questions for which students gave answers satisfactorily. Based on the recommendations of the examiners, PhD degree has been awarded to these students by Manipal University.

2. **DAC meeting:**

   Doctoral Advisory Committee meeting to was organized the to review the six-month research progress of Mr. S. Aravinda on Mar 23, 2015 at Sadashivnagar campus. It was Mr. Manjunathan's two and half years of doctoral research and his 5th DAC meeting. Doctoral committee members, Prof. Usha Devi and Prof C Sivaram attended the meeting. Dr. R. Srikanth (Guide) was present during the meeting. Mr. S. Aravinda presented his six month research work and also ongoing and future activities of his research. DAC members gave several valuable suggestions to improve the quality of research. The final DAC review meeting was organized the to review the six-month research progress of Mr. S. Aravinda on Sep 24, 2015 at Sadashivnagar campus. It was Mr. Manjunathan's three years of doctoral research. Doctoral committee members, Prof C Sivaram and Prof Usha Devi attended the meeting. Dr. R. Srikanth (Guide) was present during the meeting. Mr. S. Aravinda presented his six month research work and also ongoing and future activities of his research. DAC members expressed satisfaction on the overall progess made by the student. Although all DAC members unanimously supported thesis submission, Dr. R. Srikanth (guide) and Mr S. Aravinda felt that one further 6-month extension would be sought, which was duly obtained.

Invited Talks

1) Invited Talk: "Nonclassical properties of monopartite systems" International School and Conference on Quantum Information-2016, Institute of Physics, February 9--18, 2016.
2) Invited talk: Operationally Lorentz-covariant extensions of quantum mechanics, International Conference on Quantum Foundations 2015, National Institute of Technology, Patna, November 30 -- December 4, 2015.

Highlights of research activities (2015-16)

1. The industry project sponsored by GTC Technology Inc, USA was successfully completed on 31 October 2015 with Dr. Shanbhag as PI and Dr. Maradur as Co-PI.
2. The short term industry project sponsored by Thermax Industries, Pune on "Catalytic conversion of waste plastic to fuels" was successfully completed by Dr. Maradur.
3. 30 research articles were published in internationally reputed journals in 2015-16.
4. Best Poster Presentation award was won by Ms. Kavitha Keshava N, student of Dr. Ananda K in National Conference on Challenges and Opportunities in Mycological Research NCCOMR-2016. The poster titled "Irradiation of endophytic fungi Phomopsis sp. improves its dye degradation potential" in Madras University, Guindy campus, Chennai during Jan 8-9, 2016.
5. Poster titled "Local and Average structure of Bi*RE*WO_6 (RE = Eu and Tb) nano photocatalyst"." by Mr. Pradeep P. Shanbogh and Nalini G.Sundaram was selected for the Best Poster Award at the13th Asian Crystallographic Association conference, Held at Kolkata in December 2015.
6. A new industry project sponsored by PW Technology USA was started in January 2016 with Dr. Shanbhag as PI and Dr. Maradur as Co-PI.
7. A new project sponsored by HPCL R & D centre on light naphtha valorization was initiated in September 2015 with Dr. Shanbhag as Principal investigator.
8. HPCL R & D Centre also sponsored 2nd project on Mesoporous polymers for catalytic applications to Dr. Sanjeev Maradur as principal investigator in February 2016.
9. Dr. Nalini G.Sundaram's research proposal titled "Design of Lanthanum based Perovskite Nanoparticles for The Development of Thick Film Gas Sensor" has been granted by DST, India for extramural research funding for three years from April 2015.
10. Dr. Suresh Babu received "Early career research Award" from Department of science and technology, Government of India
11. Mr. Bharath's project has been awarded an amount of Rs. 40,000 under the TRIP (Technology Related Innovative Projects) Sponsored by VGST,Karnataka for 5 months under Dr. Nalini's supervision at PPISR.
12. Dr. Nalini and Mr.Pradeep visited the National Institute of Materials Physics in Magurele/Bucharest, Romania on 29th and 30th March, 2016 to carry out HRTEM measurements funded by the Central European Research Infrastructure Consortium (CERIC) funding.
13. P. Manjunathan gave Oral Presentation on "A novel zinc-tin composite bifunctional catalyst for the selective synthesis of glycerolcarbonate via carbonylation of glycerol with urea" at international conference on SusChemE organised by ICT, Mumbai on 8-9th October 2015.
14. Mr. Satyapal R. C. presented a poster on "Sulfonated Mesoporous Polydivinylbenzene (PDVB) as Efficient Catalyst for Room temperature Synthesis

of Solketal" at international conference on SusChemE organised by ICT, Mumbai on 8-9th October 2015.

15. Ms. Archana presented a poster in ICONSAT conference held during 29 February-2 March, 2016 Organised by IISER Pune.
16. Dr. A. B. Halgeri gave an invited talk on "Nanotechnologies and its application to Chemical Industry" at Sri Jagadguru Chandrasekaranatha Swamiji Institute of Technology, Chickaballapur on July 22, 2015.
17. Dr. A. B.Halgeri delivered an invited lecture on ""Recent Advances in Catalysis on Sustainable Chemistry" at the National Conference on Chemistry and Life organized by Poornaprajna College Udupi on August 8, 2015.
18. Dr. A.B. Halgeri gave a talk on "future Energy Challenges through Biofuel and Biorefinery Technologies" at Dayanand Sagar College of Engineering on September 25, 2015.
19. Dr. A. B. Halgeri delivered a talk on "Novel Catalytic Material and its Industrial Applications" at the University of Delhi on 9 October 2015.
20. Dr. A.B. Halgeri has been invited as the Guest of Honour for the conference on "Recent Advances in Chemical Engineering" organized by MSRIT in association with IIChE on November 30, 2015.
21. Dr. A. B. Halgeri gave a talk on "Development of Ecofriendly Catalysts for Glycerol conversion to value added chemicals" at Reliance Industry Research and Technology Centre, Mumbai on 19th Feb 2016.
22. Dr. G. V. Shanbhag delivered an invited talk for Faculty Development programme (FDP) on Applied Catalysis and Reaction Engineering, on the topic "Heterogeneous Catalysis: Concept and its importance in presentdayresearch" at Department of Chemical Engineering, MSRIT, Bengaluru on 16-07-2015.
23. Dr. G. V. Shanbhag gave invited lecture as a resource person on two topics: *i) Catalysis-Principles and applications; ii) Bio mass - Roll ofcatalysts for its conversion into energy and chemicals"*on 18-07-2015 at Dept. of Chemistry at SIT, Tumkur
24. Dr. G. V. Shanbhag delivered an invited talk for Masters Students of MIT, Manipal, on the topic "Heterogeneous Catalysis: Concept and its importance in present day research" at Department of Chemical Engineering, Manipal Institute of Technology, Manipal on February 22, 2016.
25. Dr. Nalini G Sundaram was invited to present her proposal at the Project Review Meeting organized by the UGC-DAE CSR Mumbai Centre at the HBNI complex, BARC ,Mumbai on November 2, 2015
26. Dr. Nalini G. Sundaram was invited as a resource person to deliver a talk and hands on demonstration on "Advanced Rietveld Refinement Techniques**"**, organized at the SrinivasaRamanujam Institute of Basic Sciences bythe KSCSTE, Kerala from September 11-13 2015.
27. Dr. Nalini delivered a talk as a resource person and hands on demonstration on Advanced Rietveld Refinement Techniques, at the UGC sponsored workshop titled "Structural Analysis By X-ray Diffraction" organized by the department of Physics, Pondicherry University, from Jan 28-29 2016.
28. Dr. Nalini G. Sundaram was invited to deliver a lecture at CMRIT, Bengaluru, on "Analysis of Powder Diffraction Data by Computational Techniques: The Rietveld Method" on 9 and 10 July 2015**.**

29. Dr. Ananda, K gave invited talk on “Diabetes: Complications and challenges of treatments” for the BE Biotech students at N.M.A.M. Institute of Technology, Nitte, Karkala on January 16, 2016.
30. Dr. Ananda K, gave invited talk on “Artificial blood” for B.sc students of Poornprajna College, Udupi on 29th February 2016.
31. Dr. Sujith Sarkar was Invited to give a talk at the International Center for Theoretical Science, Tata Institute of Fundamental Research on the occasion of Statistical Physics Meeting.
32. Dr. Sowmya gave a talk in the Materials Science with Neutrons Conference organized by UGC under Collaborative Research Scheme (CRS) held in BARC Mumbai In February 2017 and also presented a poster in NANO BANGALORE INDIA -2016 held in Hotel Lalith Ashok on 3–4 March, 2016.
33. Ms. Archana attended the familiarization workshop and the hands on training conducted as part of the Indian NanoUser programme at CeNSE, IISc, Bengaluru from August 3-11, 2015.
34. Raghurama P Hegde was the judge for the Science and Arts Exhibition held at Poornaprajna School, Sadashivnagar on 19 September, 2015.
35. Dr. Ananda K. was invited for the judging panel in “The Amateur Scientist' an National-level Science Fest conducted by PES University, Bengaluru on the 22 of August, 2015.
36. Dr. Ananda K. was invited to deliver a lecture on “Antidiabetic Endophytic fungi” at St. Aloysius Post graduation center, Mangalore on September 7, 2015.
37. Ms. Pavithra G C's presented poster titled “Functional insights from the structures of Purine phosphoribosyltransferases from pathogenic bacteria” at AsCA conference at Kolkata from 5 -8 Dec, 2015.
38. Dr. Shanbhag, Mr. Nagendra Kulal and Mr. Darshan Gaonkar attended the 8th Bangalore India nano conference 2016 which was held from 3 –5 March 2016 at The Lalit Ashok Convention Centre, Bengaluru.
39. Dr. Nalini and Mr. Pradeep visited the National Institute of Materials Physics in Magurele/Bucharest, Romania on 29–30 March, 2016 to carry out HRTEM measurements for the proposal titled “Evaluation of Micro structure and Phase Composition of Bi2-xGdxWO6(x = 0.2 to 1) Mixed phase Nano Photocatalysts.” The accommodation and Fight tickets are funded by the Central European Research Infrastructure Consortium (CERIC) funding
40. Mr. Bharath’s project titled “Design and Development of Multifunctional SnO_2-X_2O_5 (X=Ta, Nb) Nanocomposites and thick films for Photocatalytic and Gas Sensor Applications” applied under the TRIP (Technology Related Innovative Projects) Sponsored by VGST for B.E/B.Tech and M.E/M.Tech students has been accepted for a period of 5 months. He has been awarded an amount of Rs. 40,000 for 5 months to under my supervision at PPISR
41. Dr. Nalini Sundaram was invited as a resource person to deliver a talk on “Rietveld Refinement Method” at the UGC sponsored workshop on “Structural Analysis Through X-ray Diffraction” organized by the Physics Department, Pondicherry University from Jan 28-30, 2016
42. A review of all the PhD student’s research work at PPISR was conducted in the presence of Professor Krishnamurthy, IIT, Madras. He put forth a number of suggestions to improve the quality of research.

43. Ms. Kavitha K. N. and Mr. Kirana M. P. attended UGC Sponsored three day National Workshop on "Strategies for Recombinant Protein Production" during 25th to 27th of February, 2016 held at JSS College Mysore.
44. Mr. Kiran M. P. attended a National level conference on "Challenges and opportunities in Mycological research (NCCOMR-2016)" held on 11th and12th of February 2016 at University of Madras organized by Centre for Advanced Studies in Botany University of Madras.
45. Dr. Ananda participated in the judging panel as *Biology* expert for "The Amateur Scientist' an National-level Science Fest conducted by PES University, Bangalore for students of Grades 8 to 12 on the 22 August, 2015.

List of publications in 2015-16

1. "Novel bifunctional Zn-Sn composite oxide catalyst for selective synthesis of glycerol carbonate by carbonylation of glycerol with urea", P. Manjunathan, R. Ravishankar and G. V. Shanbhag*, **ChemCatChem** (Wiley), 2016, 8 (3), 631-639.
2. "Superior performance of mesoporous tin oxide over nano and bulk forms in the activation of a carbonyl group: Conversion of bio-renewable feedstock", V. S. Marakatti, P. Manjunathan, A. B. Halgeri and G.V. Shanbhag*, **Catalysis Science & Technology** (RSC) 2016,**6**, 2268-2279.
3. "Glycerol acetins: fuel additive synthesis by acetylation and esterification of glycerol using cesium phosphotungstate catalyst" S. Sandesh, P. Manjunathan, A. B. Halgeri, G. V. Shanbhag, **RSC Advances**, 2015, 5, 104354-104362.
4. "Green and Sustainable Tandem Catalytic Approach for Fine-Chemicals Synthesis Using Octahedral MnO_2 Molecular Sieve: Catalytic Activity versus Method of Catalyst Synthesis". B. Sarmah, R. Srivastava,*, P. Manjunathan, and G. V. Shanbhag, **ACS Sustainable Chemistry & Engineering** (ACS), 3 (11) 2015, 2933–2943.
5. "Shape-selective synthesis of para-diethylbenzene over pore-engineered ZSM-5: a Kinetic study", Janardhan L. Hodala, Yajnavalkya S. Bhat, Anand B. Halgeri† and Ganapati V. Shanbhag*, **Chemical Engineering Science** (Elsevier) 138, 2015, 396-402.
6. "Influence of alkaline earth cation exchanged X zeolites towards ortho-selectivity in alkylation of aromatics: Hard-Soft-Acid-Base concept", Vijaykumar S. Marakatti, Peddy V. C. Rao, Nettem V. Choudary, GandhamSriGanesh, Gitesh Shah, Sanjeev P. Maradur, A B. Halgeri, Raman Ravishankar*, Ganapati V. Shanbhag*, **Advanced Porous Materials** (American Scientific Publishing), 2, 2014, 1-9.
7. "Metal ion-exchanged zeolites as highly active solid acid catalysts for the green synthesis of glycerol carbonate from glycerol" V. S. Marakatti and A. B. Halgeri ***RSC Advances***, 2015, **5**, 14286-14293.
8. "$Na_{2.44}Mn_{1.79}(SO_4)_3$: a new member of the alluaudite family of insertion compounds for sodium ion batteries", Debasmita Dwibedi, Rafael B. Araujo, Sudip Chakraborty, Pradeep.P. Shanbogh, Nalini G. Sundaram, Rajeev Ahuja and Prabeer Barpanda ***Journal of Material Chemistry A***, 2015**,3**, 18564-18571
9. Invited article titled 'Fullerenes Revisited: Materials Chemistry and Applications of C60 Molecules' Pradeep P. Shanbogh Nalini G. Sundaram, **Resonance**, February 2015, 20 (02), (p.123)
10. "Photocatalysis of Bi4NbO8Cl hierarchical nanostructure for degradation of dye under Solar/UV irradiation", Swetha S M Bhat and Nalini Sundaram ***New Journal of Chemistry***, 39,3956-3963, 2015

11. "Controlled inversion and surface disorder in zinc ferrite nanocrystallites and their effects on magnetic properties", Ranajit Sai, Suresh D. Kulkarni, Swetha S. M. Bhat, Nalini G. Sundaram, Navakanta Bhat and S. A. Shivashankar, ***RSC Advances***, 2015,**5**, 10267-10274.

12. "Molybdenum oxide/g-alumina: an efficient solid acid catalyst for the synthesis of nopol by Prins reaction" Vijaykumar S. Marakatti,Dundappa Mumbaraddi, Ganapati V. Shanbhag, Anand B. Halgeri and Sanjeev P. Mardaur* ***RSC Advances,*** 2015, 5, 93452-93462.

13. "Synthesis of focused library of novel aryloxyacids and pyrazoline derivatives: Molecular docking studies and antimicrobial investigation", Shubhalaxmi, Pathak L**,** Ananda K, Bhat KS. **Cogent Chemistry,** 2016 (accepted):1141388.

14. "Pyrimidinethione derivatives with tosyl substitution: Synthesis, and antimicrobial property investigation", Shubhalaxmi NA, Manjunatha BS, **Ananda K**, SubrahmanyaBhat K. *J. Appl. Pharm. Sci.,* 2016; 6(xx), (xxxx) (in press).

15. "Fabrication of polydopamine functionalized halloysite nanotube/polyetherimide membranes for heavy metal removal", Hebbar RS, Isloor AM, Ananda K, Ismail AF. **Journal of Materials Chemistry A.** 2016, 4(3), 764-74.

16. "1,3,4-Trisubstituted pyrazole bearing a 4-(chromen-2-one) thiazole: +synthesis, characterization and its biological studies", N Harikrishna, Arun M Isloor, K Ananda, Abdulrahman Obaid, Hoong-Kun Fun, ***RSC Advances***, 2015, *5*(54), 43648-43659.

17. "Quantum Simulation of Dirac Fermion Mode, Majorana Fermion Mode and Majorana-Weyl Fermion Mode in Cavity QED Lattice", Sarkar S., **Euro Physics Letters**, 110: 64003, 2015.

18. "Existence of Majorana Fermion Mode and Dirac Equation in Cavity QED Lattice", Sarkar S., Physica B 48:475, 2015.

19. "The essence ofnonclassicality: Non-Vanishing Signal Deficit", S. Aravinda and R. Srikanth., **Int. J. Theor. Phys.** 54, 4591 (2015).

20. "A quantum information theoretic analysis of three flavor neutrino oscillations", G N Chandan, N. Banerjee, Sujit Sarkar, **Journal of Physical Society of Japan**, 2015.

21. "Toward secure communication using intra-particle entanglement", Subhashish Banerjee, Ashutosh Kumar Alok, R. Srikanth and Beatrix C. Hiesmayr., **European Physical Journal**, C, 75: 487,2015.

22. "A Simplified Hierarchical Dynamic Quantum Secret Sharing Protocol with Added Features". Hanaan Hashim and R. Srikanth., **INDECS** 13: 354, 2015.

23. "Complementarity between signalling and local indeterminacy in quantum nonlocal correlations", Sandeep Mishra, Chitra Shukla, Anirban Pathak, R. Srikanth, **Int. J. Theor. Phys**. 54: 3143, 2015.

24. "Complemetarity between signalling and local indeterminacy in quantum nonlocal corrections", S. Aravinda & R. Srikanth, **Quantum Information & Computation**,15, 0308-0315, 2015.
25. "Extending quantum mechanics entails extending special relativity" S. Aravinda and R. Srikanth, **J. Phys. A**: **Math. Theor.** 49, 205302 (2016). arXiv:1506.03058
26. "The Unruh effect interpreted as a quantum noise channel", S. Omkar, Subhashish Banerjee, R. Srikanth, Ashutosh Kumar Alok, **Quantum Information & Computation** (QIC) 2016, (accepted) ArXiv:1408.1477.
27. "Counterfactual distribution of Schrödinger cat states", Akshata Shenoy-Hejamadi and R. Srikanth, **Phys. Rev. A** 92, 062308 (2015).
28. "Quantum code for quantum error characterization", S. Omkar, R. Srikanth, and Subhashish Banerjee, **Phys. Rev. A,** 91, 052309 (2015).
29. "Toward secure communication using intra-particle entanglement", S. Adhikari, D. Home, A. S. Majumdar, A. K. Pan, Akshata Shenoy H. and R. Srikanth, **Quantum Info. Processing** 14, 1451 (2015).
30. "The operator sum-difference representation for quantum maps: application to the two-qubit amplitude damping channel", S. Omkar, R. Srikanth, Subhashish Banerjee, **Quantum Information Processing** 14, 2255 (2015).

Events and meetings

1. Celebration of Founder's Day and Graduation Day



Poornaprajna Institute of Scientific Research celebrated Founder's Day and Graduation Day on July 24, 2015. Every year Founder's Day is celebrated in fond remembrance of H.H. Sri Vibudhesha Theertha Swamiji's dedication for the advancement of science in India. Bharat Ratna Prof. C N R Rao was the chief guest on this occasion. H.H. Sri Vishwapriya Theertha Swamiji, President AMEC and AMEF, Bengaluru presided over the function. The programme was attended by a large number of audience including Trustees of AMEC and AMEF, Well wishers of PPISR, School teachers and staff's of all Poornaprajna schools in Bengaluru, all the members of PPISR and other invitees were present. The programme began with a prayer by Poornaprajna School Students, Yelahanka followed by lighting of the lamp. Prof. K. Srihari, Honorary Secretary, AMEC & AMEF welcomed all the guests. On this occasion, nine students who have been awarded PhD from PPISR under Manipal University received certificate of appreciation from Prof. C N R Rao and blessings from H.H. Sri Vishwapriya Theertha Swamiji with shawl. The nine doctorates are Dr. Swetha Sandesh, Dr. Vijaykumar Marakatti, Dr. Janardhan H L, Dr. Suhas D. P., Dr. Swetha S. M., Dr. Srinidhi Raghavan (all Materials Science), Dr. Saitsh L. and Dr. Pavithra N. (Biological Sciences) and Dr. Omkar S. (Theoretical Sciences). Dr. Ananda read the PhD highlights of each student to the audience. In this programme, the philanthropic donors to the newly built hostel were honoured by H.H. Sri Vishwapriya Theertha Swamiji. On this historical event, our first issue of 2015 Newsletter was released by Bharat Ratna Prof. C N R Rao.

The Management and AMEF Trustees felicitated Dr. A. B. Halgeri, Director of PPISR for his contribution in the growth of PPISR and for showcasing the institute at national and international levels. Dr. K. Srihari, Honorary Secretary, AMEF and AMEC and Sri. P. Sreenivasa Rao, Financial Advisor for AMEF were also felicitated on this occasion. Dr. Ganapati V Shanbhag and Dr. Sanjeev Maradur were also received appreciation plaque of GTC, USA for successfully completing the design and development of 1st and 2nd generation catalysts for toluene methylation technology ready for commercialization. One of the close associates of H.H. Sri

Vibudhesha Theertha Swamiji, Sri. S. Devendra Pejathaya who always accompanied Swamiji while establishing PPISR was also invited for this function and felicitated. Dr. A .B. Halgeri expressed his views about PPISR and said that a technology developed by PPISR in collaboration with an industry is set to be commercialised soon in China. He talked about the close association of Prof. C N R Rao with H.H. Sri Vibudhesha Theertha Swamiji. He also gave a brief overview of the research activities at PPISR. Dr. Ramagopal introduced the chief guest, Prof. C N R Rao to the audience.



Prof. C N R Rao while addressing the gathering recalled his association with H.H. Sri Vibudhesha Theertha Swamiji, Founder Chairman of PPISR. Prof. C N R Rao said that founder Swamiji was extremely excited about science. Recollecting his deep association with PPISR, he remembered how H.H. Sri Vibudhesha Theertha Swamiji just turned up at his house and shared his vision of starting an institute dedicated for science research. Addressing the large group of school teachers and researchers who had assembled, he said that as long as we are alive, let's work for science and education. Talking about nine students who finished PhD degree from PPISR, he said “PhD is not even the first step, the first step comes after PhD where young scientists has to face more hurdles”. He applauded the research progress of PPISR on this occasion.


His Holiness Sri Vishwapriya Theertha Swamiji, in his benediction said that it's foolish to try to please humans. However, it's possible to please God. He asked people to serve society in whatever way they can. It's the right way to pay taxes to the God for all the facilities HE has provided. Poojya Swamiji also thanked teachers' spouses for letting them serve the purpose of education. Dr. Ganapati V Shanbhag delivered vote of thanks and Dr. Nalini G Sundaram compered the whole programme on this occasion.

2. Bharat Ratna Professor C N R Rao laboratory for Materials Science

Bharat Ratna Prof. C N R Rao, Fellow of the Royal Society, speaking on this occassion expressed his association with H.H. Sri Vibudhesha Theertha Swamiji and said that present scientists should adore their research in science. Prof. C N R Rao appreciated the growth of PPISR during the past few years and said that the credit goes to founder Swamiji. He also mentioned that a research institute should concentrate on increasing brain size and not on building size. In his speech he announced that he and his wife Dr. Indumati Rao would donate a laboratory building to Poornaprajna Institute of Scientific Research, Bengaluru. The new laboratory would focus on material science research, one of the area's of Prof Rao's expertise. He also announced one research fellowship award for a student in the area of materials science. Foundation stone for Prof. C N R Rao research laboratory in Materials Science has been laid on November 2, 2015 by H.H. Sri Vishwapriya Theertha Swamiji. The construction work of the laboratory is going on in full pace and it is expected to be inaugurated on the occasion of Founder's Day 2016.

3. Scientific programmes on Founder's Day celebration

As a prelude to the Founder's Day Celebrations, scientific lecture sessions were arranged on July 13-14, 2015, where distinguished scientists were invited to deliver lectures on various fields. The scientific session was inaugurated by Prof. D. N. Rao, Chairman, Biological Sciences Division and Professor, Department of Biochemistry, IISc, Bengaluru on July 13, 2015. He gave an eloquent talk on restriction-modification systems in bacteria and usefulness of this techniques in modern molecular biology. He discussed about many such systems worked out in his research group. The Materials Science department technical session had began with a invited talk by Professor. Dr. A. V. Ramaswamy, Former Deputy. Director, HOD, Catalysis Division NCL, Pune and former Chair Professor, NCCR, IIT-Madras. He delivered a lecture on "Designing Functional Ceria Materials by Nano-architecture". Followed by internal speakers Dr. Ganapati V Shanbhag and Mr. Manjunathan spoke on role of catalysis on biomass conversion and synthesis of glycerol conversion respectively. Second part of scientific session was chaired by Dr (Mrs). Veda Ramaswamy, Former Dy. Director, NCL, Pune and Former Head, CPL Division, CLRI, Chennai. Dr. Nalini G Sundaram spoke on role of Perovskite Based Nanoparticles in Gas Sensing Applications, Dr. Sanjeev P Maradur delivered a lecture on Catalytic applications of mesoporous polymers. Mr. Pradeep Shanbog discussed on synthesis of isothermal photocatalysts in his presentation.

The scientific Lectures were continued on July 14, 2015 for the Biological Science and Theoretical Science Divisions. In Biology Dr. Nagasuma Chandra, Professor from IISc, Bengaluru delivered an invited talk on applications of systems biology in understanding the biological structures. This was followed by lectures by Dr. Ramagopal U A on structural biology research at PPISR and Dr. Ananda K on enzyme inhibitors from endophytic fungi. Ms. Swetha L discussed about exploring of new immune check point inhibitors in her presentation. Prof. Nagasuma Chandra chaired the biological sciences technical session and summarized all the presentations to the audience. Dr. N.S. Vidhyadhiraja, Professor, JNCASR delivered an invited talk on "A glimpse into the fascinating world of interacting quantum systems" and later chaired the session for Theoretical Science. Dr. Srikanth, Mr.Aravinda and Mr.Nepal Banerjee gave talks on quantum theory and cryptography related topics. The scientific session was concluded with the vote of thanks.

4. Unveiling of H.H. Sri Vibudhesha Theertha Swamiji's Bust

The Founder President of PPISR, H.H. Sri Vibudhesha Theertha Swamiji, was renowned for his espousal of scientific research and science education, unusually for the Pontiff of a traditional Hindu religious institution. He gave this passion of his a concrete form in establishing PPISR as a primarily research Institute, among the Poornaprajna family of educational institutions. He dreamed ofit as a peaceful and quiet place for dedicated scientists to pursue research that would be at par with that of their best international peers. It is fair to say that today we are more confident than ever of evincing a high level of progress and fulfilling Swamiji's vision for this institution. The growth of PPISR is infused with his invisible and benign power. It thus seems most apt, on this occasion of the first batch of PhD students successfully graduating from PPISR, to commemorate the life and achievements of Founder President H. H. Sri VihudheshaTheertha Swamiji by installing his bust at the PPISR campus. H.H. Sri Vishwapriya Theertha Swamiji unveiled the bust on July 24, 2015 on the occasion of this year's Founder's Day celebration in the presence of Prof. C. N. R. Rao. On this occasion, Dr. A. B. Halgeri, Dr. K. Srihari, Sri. Sreenivasa Rao,

members of AMEC and AMEF, as well as the faculty, students and staffof PPISR were also present.

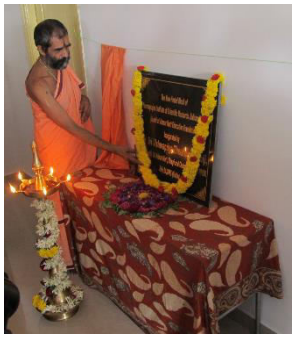
5. Felicitation to Dr. A. B. Halgeri

The following citation was presented to Dr. A. B. Halgeri for his significant contributions to PPISR during Founder's Day 2015

"In 2010, Dr. Halgeri assumed responsibility as Director of the Poornaprajna Institute of Scientific Research, a bold and challenging effort started by H.H. Sri Vibudhesha Theertha Swamiji as a unique Centre for scientific research outside of the Government, perhaps the only one of its kind in the non Governmental sector in the whole country. At the time he took over as Director, the Centre was in its infancy and was still struggling to define its role and scope of work with severe limitations in infrastructure and scientific equipment, very few projects and scientists. With his quiet and unassuming but effective style of functioning Dr. Halgeri has been successful in breathing life and energy to the Centre. Some of the achievements during the last five years of his leadership ofthe Centre are establishment of units for research in the areas of Materials Science, Theoretical Science and Biological Sciences; a tie up with Manipal University to offer Doctoral programmes at the Centre, commencement of industry sponsored research projects, establishment of a students' hostel, construction of an independent chemical laboratory. Under the dynamic leadership of Dr. Halgeri, PPISR has taken up several research programmes sponsored by both industry as well government agencies. The Board of Trustees looks forward to the continued service to the Poornaprajna Centre for Scientific Research and to the research fraternity working at the Centre. On behalf of AMEF Management, the citation was read by Shri Rajendra Hinduja as a token of recognition and appreciation of his contribution to the growth of Poornaprajna Centre for Scientific Research and good wishes for a many more years of service to the Centre and the cause of Science. This citation was presented by His Holiness Sri Vishwapriya Theertha Swamiji to Dr. Halgeri on the occasion of the Founder's Day in the august presence of the greatest living scientist in India Bharat Ratna Prof. C N R Rao".

6. Inauguration of New Hostel Building

The expansion of research activities at PPISR has necessitated the induction of additional doctoral students. Therefore the existing hostel facilities were expanded for additional accommodation. The new hostel building was built with the support of philanthropic donors and AMEF funding. The new hostel building has 10 independent rooms to accommodate 20 PhD students, two guest rooms, a meeting hall and a kitchen. H.H. Sri Vishwapriya Theertha Swamiji inaugurated the newly built hostel on July 24, 2015 by unveiling on the occasion of Founder's day. Ganahoma was also performed by the PPISR family on this occasion.


There are many donors came forward to contribute for this good cause and list of present donors is as follows.

- Sri Admar Mutt, Udupi
- Sri H.L.Suresh, New Delhi, Trustee, AMEF
- Smt. Shobha Suresh, New Delhi
- Smt. Sunanda Devi (Mother of Dr. U Shankar Rau, Chennai, Trustee, AMEF)
- Sri Rajendra J Hinduja, Bengaluru, Trustee, AMEF
- Sri Laxmish G Acharya, Mumbai, Trustee, AMEF
- Sri V Venkata Reddy, Bengaluru, Senior Member, PPEC Indiranagar & Industrialist
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- Smt. Bhuvaneshwari and Sri V Tulasiram, Bengaluru, Parent Indiranagar & Corporator BBMP
- Smt. Bhagya Nanjappa,Bengaluru, Parent, Indiranagar
- Dr. Shivaraj Patil, Raichur, MLA, Parent, PPEC Sadashivanagar
- Parents and Staff Members of Widia Poornaprajna School Bengaluru, Lt. Col. Rajaram Hon. Secretary PPEC Widia
- Parents and Staff Members of PPEC Indiranagar, Bengaluru, Sri S.K.Bhat Hon.Secretary PPEC Indiranagar
- Sri V Prashanth and R Nagesh, Bengaluru, Building Contractors
- Sri K.N.Hari Bhat, Jt. Secretary PPEC Yelahanka
- Sri S.T. Raghavendra Mady , Bengaluru

7. Board of Trustees Meeting

The Board of Trustee Meeting was conducted to review the progress of the Institute, to discuss the budget requirement and also the new facilities that needs to be created at PPISR. The Chairman H H Sri Vishwapriya Theertha Swamiji presided over the meeting. The Director made a presentation on the overall progress of the Institute. The trustee members perused the PhD thesis submitted by the first batch of doctoral students and expressed their happiness on the successfully completion of PhD programmes by the first batch of doctoral students .They also complemented the efforts of the faculty members on this occasion. The second volume of News Letter for the year 2015 was released by Trustee member Padma Bhushan Prof. U R Rao.

8. Catalysis Society of India, Bengaluru Chapter

In order to bridge the gap between Academia and Industrial R&D, it has been planned to establish the Catalysis Society of India, Bengaluru Chapter with Dr. A.B. Halgeri as the President and Dr. Y.S. Bhat as the Secretary and few Senior Scientists from IISc, JNCASR, SABIC (R&D), HPCL, Shell Technology Centre and Professors from various Research Institutes as Executive Committee Members. The first meeting of CSI Bengaluru Chapter was held on October 3, 2015 at PPISR campus to discuss the "Road map of Catalysis Research in India" in the presence of Executive committee members. At the conclusion of the meeting, PPISR has been identified as the nodal institute for CSI, Bengaluru Chapter. Overall, the meeting was quite successful and encouraging.

9. Commencement meetings of two HPCL Sponsored Projects

Since the 2-year project sponsored by HP Green R & D Centre was successfully completed in October, 2014, HPCL showed a keen interest in giving a new project to the Catalysis Group. Dr. Shanbhag wrote a new proposal for a two year project after several discussions with HPCL team.

After finalizing the technical and budgetary aspects, project proposal review meeting of new HPCL sponsored project was held at PPISR on July 31, 2015. From HP Green R & D Centre, Dr. N V Choudhary (General Manager), Dr. Peddy V C Rao (Dy. Gen. Manager), Dr. Raman Ravishankar (Senior Manager) and Dr. Sudarshan Reddy attended the meeting. From PPISR, Dr. A. B. Halgeri, Dr. G. V. Shanbhag and Dr. S. P. Maradur were present. Dr. A.B. Halgeri presided over the meeting. Dr. G. V. Shanbhag gave a presentation on the new HPCL proposal. Various aspects of the proposal were discussed and few changes in the proposal were suggested.

Subsequently, Project kick off meeting was held at HPCL R & D Centre, Devanagondi was held on September 24, 2015. Dr. G. V. Shanbhag, Principal Investigator of the project, presented the details of the final project proposal to the HPCL members. Dr. Halgeri and Dr. Maradur were also present during the meeting. HPCL team expressed their satisfaction about the proposal and gave approval for the same. Subsequently, the project was initiated by PPISR.

HP Green R & D Centre also sponsored 2nd project which started from 1st Feb 2016 for a period of two years. The research work is aimed at **"**Development of Novel Polymer Based Catalysts for Low Temperature Catalytic Applications" with Dr

Maradur as PI and Dr Shanbhag as Co-PI. The Project kickoff meeting was held on 2nd Feb 2016. Dr. Maradur made a presentation on the research topic undertaken in the sponsored project and action the plans of executing it. Several points were discussed during the meeting which included preparation of novel catalyst systems, model test reactions and target products.

10. VGST Sponsored project awarded to Materials Science

Vision group on Science & Technology (VGST), Govt. of Karnataka awarded a project under the category of establishment of "Centre of Excellence in Science, Engineering and Medicine" (CESEM) to Dr. Ganapati V. Shanbhag, Materials Science Department for his project proposal on "Chemical fixation of CO_2 by converting into value-added chemicals by metal modified nanoporous silicate catalysts" for the period of 3 years. Hon'ble Minister for Planning and Statistics, IT, BT, Science & Technology Sri S.R. Patil handed over the cheque of first year grant to Dr. Ganapati Shanbhag in an event organized on April 23, 2015 by VGST.

It is important to note that VGST is constantly supporting PPISR by giving sponsored projects and it is the 4thgrant received by PPISR.

11. Visit of Dr. Ding ZhongYi, GTC USA for review meeting

Dr. Ding ZhongYi Technology Process Manager, GTC USA visited PPISR on 27-28 April 2015 to review the progress of new GTC sponsored project started from November 2014. Previously, the Catalysis group of PPISR successfully conducted 3 years GTC sponsored project on "Design and development of catalyst and process for alkylation of aromatics" This work at PPISR led to the development of a new TolAlk technology announced world wide by GTC and subsequently licensed to a China refinery. For the ongoing new project, there were discussions on the progress made during 6 months during the technical review meeting chaired by Dr. A. B. Halgeri. Dr. Ganapati Shanbhag and Dr. Sanjeev Maradur made technical presentations about the progress of the project and literature related to the subject. Dr. ZhongYi expressed his satisfaction on the progress and milestones achieved during this period.

12. Initiation of project sponsored by Thermax Industries

Dr. Nagesh S. Kini, Principal Scientist and Head, Centre of Excellence-Materials Science, R. D. Aga Research Technology Innovation Centre, Thermax Industry, Pune visited the institute on 10 June 2015. Technical meeting was held in order to discuss the possibility to take up a sponsored program on "Plastics to Fuels" project. Prof. A. M. Umarji, Chairman, MRC, IISc, Dr. A. B. Halgeri, Dr. Ganapati Shanbhag

and Dr. Sanjeev Maradur were present at the meeting. Based on the discussions, Thermax sponsored an exploratory collaborative project to PPISR on a very challenging "catalytic conversion of waste plastics to fuels" aimed at commercialization of the technology for domestic applications to eradicate the menace ofthe pollution due to plastic wastes in cities. This short term project was successfully completed.

13. Teachers' Day celebration

Teachers' Day was celebrated at PPISR on September 5, 2015. Dr. Kishan Gurram and Dr. Rajeshwar from SABIC Technology Centre gave invited lectures followed by lectures by PPISR faculty members on this occasion. Dr. Kishan Gurram, Site Head, SABIC gave a talk on "Challenges & tools for catalysis research in petrochemicals industry". Dr. Rajeshwar, Head of Catalysis Group at SABIC gave a talk on "Catalyst development and scale up experience". Faculties of Materials Science briefed about their ongoing research activities to the audience.

14. Appreciation Award by GTC, USA

A plaque was awarded by GTC Technology Inc, USA to Catalysis Group in recognition of the successful completion of the GTC sponsored project 2013-2014 where, Catalysis Team led by Dr. G. V. Shanbhag and co-investigated by Dr. S. P. Maradur developed 2nd generation catalyst for toluene methylation process. The plaque reads as follows, *"Presented to Dr. Anand B. Halgeri – Director, Dr. Ganapati V. Shanbhag – PI, Dr. Sanjeev P. Maradur – Co-PI and students, Mr. Prashant Kumar R. K., Mr. Karthik N. C., Mr. Santosh Kumar Jalannavar, in recognition oftheir successful development of second generation zeolite-based catalyst for aromatics production suitable for commercial exploitation in future.GTC Technology US, LLC, is grateful for the full support of Poornaprajna Institute of Scientific Research Management and looks forward to ourlong-term relationship".*

15. Dialogue on Indian Philosophy and Modern Science

The "Center for Foundational Study" (CFS) at PPISR attempts to bridge the two knowledge systems of science and philosophy, as a particular interpretation of the dream held by Senior Swamiji H H Sri Vibudhesha Theertha Swamiji. On Dec 8, 2015, a one-day international symposium titled "Science Meets Oriental Philosophy - 2015" was held at the Bidalur campus under the aegis of CFS. Organized by Dr. R. Srikanth, together with Prof Sisir Roy of NIAS, IISc and Dr Debajyoti Gangopadhyay, Annada College, Hazaribad, Jharkhand, it brought together professional scientists in mathematics, philosophy, physics, computer science and history from the world over, among them Prof. Narasimhan (NIAS, Bengaluru, India), Prof. Alex Hankey (SVYASA, Jigani, India), Prof. Ralph Abraham (Univ. of California, Santa Cruz, US), Prof. Henk Barendregt (Chair Found. Math. Comp. Science, Radboud University, Nijmegen), Dr. Ravindra Pinna (Akash Hospital, Bengaluru, India) and Mr Marek Lyczka (Jagiellonian University in Krakow, Poland). The topic of the nature of Reality, Knowledge and individual identity, were discussed.

16. One-day seminar in honour of 71st Birthday of Dr. A. B. Halgeri

The faculty members of PPISR, honored the Director, Dr. A. B. Halgeri, on his 71st Birthday by arranging a scientific session comprising of lectures by faculty members on the various research activities carried out by them. In the morning session the talks covered a wide range of appealing and current research topics such as quantum simulations of fermions light-Matter systems, polyoxometalates catalysts, advanced nanomaterial gas sensors, conversion of Natural gas to acetic acid, the nonclassicality of monopartite system. In the afternoon session, the talks were on Borophene, Changing research scenario in immunotheraphy and finally on Carnivorous fungi. The talks brought out the diverse nature of basic and applied research carried out at PPISR. The interesting technical session was

followed by a Valedictory function, where Prof. Y S Bhat was the Chief Guest. The valedictory session was attended Prof. K. Srihari, Secretary, AMEF and AMEC, Sri. Sreenivasa Rao, Financial Advisor, AMEF and AMEC and Mrs. Halgeri. The chief guest and the other honoured guests for this occasion felicitated Dr. Halgeri on his Scientific achievements and contributions to PPISR. As a token of their respect to the director, the faculty presented him a memento. This seminar ended with an inspiring speech by Dr. Halgeri to the audience.

17. One day workshop on "Advances Of Theoretical Condensed Matter Physics"


A one day workshop on "Advances of Theoretical Condensed Matter Physics" was organised on March 09, 2016 at the Bidalur Campus and was sponsored by PPISR. The meeting was coordinated by Dr. Sujit Sarkar from the Theoretical Physics Department. PPISR. The Director welcomed the delegates of the workshop followed by lighting the lamp. Prof. S Vidyadhiraja of JNCASR gave the inaugural and further it was followed by various topics by various speakers. This meeting consists of two sessions. First Session was on the advances in research progress in statistical physics. Prof. Prabal Maiti (IISc, Phys), Prof. Sanjeev Shabhapandit (RRI), Prof. Subir Das (JNCASR) presented talks The second session of this meeting is on the Topological State of Matter for Quantum Many Body Systems. Prof. N. Vidyadhiraja, Prof. Diptiman Sen, Prof. Subroto Mukherjee and Prof. Vijay Shenoy have presented talk in this session. Dr. Pallab Basu of ICTS/TIFR was the chair of the sessions

18. Winter School for undergraduate Students of PP College


A five day Winter School in Physics, Chemistry and Biology was organised at Bidalur Campus for the under graduate students of PPC, Udupi from 4th to 8th January, 2016. The School was intended for undergraduate students to get a glimpse of current research and applications. The school was inaugurated by Prof. K G Satyanaraya followed by lectures in chemistry, Biology and physics. The

programme was designed so that the students were exposed to a healthy mix of lectures as well as laboratory sessions.

The lectures covered on topics such as Catalysis-concept and its importance in present day research, Material characterization techniques, introduction to material science, research guidance for undergraduate students, thin film technology, Nano materials, advances in polymers, a few basic aspects of quantum magnetism, mysteries of quantum mechanics, simple harmonic motions, gene to structure, applications of plants and fungal metabolites, epigenetic and hands on experience practical classes. The valedictory address was given the chief guest Prof. Ranga Uday Kumar of JNCASR, Bangalore.

19. Out-reach programme for high school students


The outreach programme for all the Poornaprajna schools of Bangalore was organised at PPISR for the third consecutive year. All the class IX students from the five PP schools in and around Bangalore participated in the programme for five days starting from 22nd February to 25th February, 2016. This program has been designed to give high school students an opportunity to view the research facilities at PPISR first-hand and experience activities undertaken by current research students. The objective was to inspire high school students to pursue higher studies and further research in fundamental and basic sciences. Many simple reactions such as use of catalyst, reason for colours in transition metal salts, the presence of phosphoric acid in Coke etc. were demonstrated by research scholars to the students. In biology, observation of different stages of mitosis, staining and examination of bacteria, growth of a crystal etc were shown. The students were also given a glimpse of the various sophisticated experiments in the materials as well as the biology laboratories. Finally a valedictory session which consisted of discussions about the experiments with the students as well as obtaining feed back about the sessions was held at end of each day.

20. Research Advisory Committee meetings

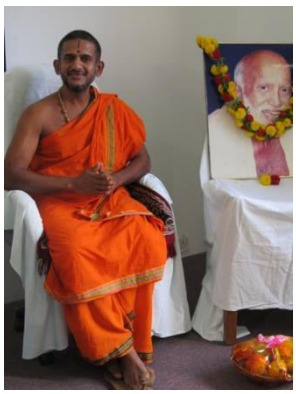
RAC meeting was organized to review the progress of the faculty members of Biological Sciences as well as Materials Science departments. Dr. A J Rao, Honorary and Emeritus Professor, Biochemistry Unit, IISc and Prof Ramakumar, Department of Physics were the subject experts for Biological Sciences group and Prof T N Gururow and Prof K R Krishnamurthy, IIT, Chennai were the subject experts for Materials Sciences group. All faculty members in both the departments made a detailed presentation on the overall progress they have made during the year 2015-

16 and all the above subject experts gave very good opinion on the excellent research work carried out in the area of Materials and Biological Sciences.

21. Visit by Prof. Pandurang Ashrit, University of Moncton, Canada

Prof. Pandurang V Ashrit, Director, Thin Films and Photonics Research Group (GCMP) at the Université de Moncton, Canada, visited Poornaprajna Institute of Scientific Research on a two month sabbatical in September 2015. His group is internationally known for its contributions to research in the fields of photonics, optics and thin films. He gave a talk on "Transition Metal Oxides based Chromogenic Thin Films and Devices" on October 1st 2015 at PPISR Further, he proposed to establish a new collaborative research project with PPISR in the area of thin films. His research is focussed on the coating of transition metal oxide (TMO) thin films by electro deposition technique. Dr. Nalini G Sundaram , Asst. Professor Poornaprajna Institute of Scientific Research and her group presented two proposals titled "Deposition of Transition Metal Oxides by Electro chemical Deposition" and "Design of Tin oxide based multifunctional nanocomposties for Gas sensors, Photocatalysis, Optical and electrochemical applications" in order to establish collaborations with his group in Canada. Presently, the work on deposition of Transition Metal Oxides by Electro chemical Deposition is already initiated by the group.

22. Visit of H.H. Sri Vishwa Prassanna Theertha Swamiji, Pejawar Mutt



H.H. Sri Vishwa Prasanna Theertha Swamiji, Junior Pontiff of Pejavar Mutt Udupi visited PPISR Institute on August 27, 2015. He visited different research laboratories of PPISR and discussed about the on going research activities. In his benediction to the gathering assured of helping PPISR from Pejawar mutt in all possible ways. Dr. A.P. Bhat, Professor, Poornaprajna College Udupi was accompanied Swamiji and introduced Swamiji to the audience. Prof. K. Srihari, Prof. A. B. Halgeri and other members of PPISR were also present on this occasion.

23. Construction of Bharat Ratna Prof. C N R Rao Laboratory for Materials Science

The construction of Bharat Ratna Prof. C N R Rao Laboratory for Materials Science tarted in November 2015. H H Sri Vishwapriya Theertha Swamiji visited Bidalur campus on March 2nd, 2016 and reviewed the construction of the laboratory. It is scheduled to be completed in July 2016 and the inauguration of the laboratory is fixed on the Founder's Day 2016.

24. Safety Practices First: Regular Fire Safety Drill

In order to make our institute a safe place to teach, learn and carry out research, PPISR conducts fire and safety drills every six months. The urpose of the drill is to create awareness about the safety practices while doing research. The students from both of Materials science as well as the Biological Sciences departments attended the drill. Other than regular checking of the fire extinguishers, these drills provide training to students, staff and faculty so they are aware what to do in an actual fire and other emergency situations

New Research Students (2015-2016)

1. **Mr. Nagendra Kulal**: He obtained his BSc from Poornaprajna College, Udupi in 2012 and MSc from St Aloysius College, Mangalore 2014. He joined PPISR in August 2015 as a PhD student under the guidance of Dr. Ganapati Shanbhag in a sponsored project.

2. **Mr. Darshan Gaonkar**: He obtained his MSc from Kuvempu University with Organic Chemistry as specialization. He worked as a Lecturer in a PU College in Murudeshwar before joining PPISR in September 2015. He is doing his research under the guidance of Dr. Ganapati Shanbhag in a project sponsored by HPCL, Bengaluru.

3. **Mr. Shankar Kundapura**: He joined for research under Dr. Ramagopal Udupi in biological sciences. He completed his MSc in Biomedical Sciences from Symbiosis International University, Pune and PG Diploma in Cell and Molecular diagnostics from KSOU, Karnataka.

4. **Mr. Kiran MP**: He completed his MSc in Applied Botany Mangalore University and joined for t the project on antidiabetic compounds from endophytic fungi and medicinal plants.

5. **Ms. Shrilakshmi S**: She completed her MSc in Biochemistry and joined for research in modification oftherapeutic protein for controlling diabetes.

6. **Mr. Vasudeva Rao:** He obtained his M.Sc. in Inorganic chemistry from Andhra university in 2014 with distinction. He joined group ofDr. Suresh in November 2015 and is going to pursue his PhD degree in the area ofmetal-organic frameworks (MOFs).

7. **Mr. Manjunath Doddamani**: He joined Catalysis group of Dr. Ganapati Shanbhag as a Research Fellow in the industry project sponsored by PW Technology, USA. He obtained his MSc in Chemistry with first class from Ranichennamma University, Belagavi and studied at Basaveshwar Science College Bagalkot. Previously, he worked as a Laboratory Chemist for the period of 1 year in a cement company.

8. **Mr. Mahesh Kumar T.:** He obtained his MSc in Chemistry with first class from Bangalore University and studied at Al-Ameen college, Bengaluru. Previously, he worked as Chemist in Bio Control research Lab in Doddaballapura for 1 year and 3 months. He has joined Dr. Shanbhag as a Research fellow in the industry project sponsored by PW Technology, USA.

Invited Talks

1. **Prof. Parimal Parikh,** Department of Chemical Engineering, SV-NIT, Surat, delivered a lecture titled "Mesoporous zeolites and their applications" on June 10, 2015.
2. **Dr. A. S. Prakash,** Scientist, CECRI, Chennai Unit, delivered a lecture titled "Materials development for efficient energy storage in batteries: From consumer electronics to automobiles" on June 5, 2015.
3. **Dr. Vasudeva Siruguri,** Centre Director, UGC-DAE Consortium for Scientific Research, Mumbai, delivered a lecture titled "Neutron scattering – A versatile probe for condensed matter" on May 27, 2015, highlighting the facilities available for neutron diffraction at the centre.
4. **Dr. M. Sudhakar Reddy,** Professor, Dept. of Biotechnology, Thapar University deleivered a lecture titled "Induction of metallothioneins in response to heavy metals and their involvement in metal tolerance in fungi" on May 14, 2015.
5. **Prof. K. R. Krishnamurthy**, Chair Professor, NCCR, IIT Madras, delivered a lecture titled "Advances in Photo Catalysis" on May 5, 2015.
6. **Dr. B. M. Reddy,** Chief Scientist & Head Inorganic & Physical Chemistry Division, IICT, Hyderabad and Professor, Academy of Scientific & Innovative Research delevered a lecture titled "Designer Catalysts for Energy and Environmental Applications" on Apr 16, 2015.
7. **Dr. Angshuman Roy Choudhury,** IISER, Mohali delivered a lecture titled "Polymorphs, Salts and Cocrystals of Drugs and Pharmaceuticals: Enhancement of Physicochemical Properties for Better Formulations" on Feb 27, 2015.
8. **Prof. M.S. Sudhakar Reddy**, Thapar University, Patiala, Punjab gave an invited lecture entitled "Induction of metallothioneins in response to heavy metals and their involvement in metal tolerance in fungi" on May 14, 2015.
9. **Prof. Chaitanya Lekshmi**, Chemistry, CMR Institute of Technology, Bengaluru gave an invited talk on Nanostructured Functional Materials: From Spin Selective Transport to Organic Resistive Switching Structures and More" on 4th September, 2015.
10. **Prof. Pandurang Ashrit**, Director, Thin Films and Photonics Research Group, Dept. of Physics and Astronomy, Université de Moncton. Moncton, N.B., Canada, gave a talk on "Transition Metal Oxides based Chromogenic Thin Films and Devices" on 1st October 2015.
11. **Prof. Balaji R. Jagirdar**, IISc, Bengaluru gave talk on "Solvated Metal Atom Dispersion (SMAD) and Digestive Ripening: duo par excellence for Diverse Nanostructured Materials" on October 14, 2015.
12. **Prof. Ajay Dalai**, University of Saskatchewan, Canada delivered a lecture on "Capabilities of Catalysis and chemical reaction Engineering laboratories (CCREL)" on December 1, 2015.
13. **Dr. Girish Rao,** Shell Technology Centre, Bengaluru gave a talk entitled "Delivering Technology in a Carbon Constrained World" on Feb 17, 2016
14. **Dr. Pramod**, University of Missouri,USA delivered a talk on 'Plant resistance to hytopathogenic Nematodes' . USA on 27th May , 2016

In-house Seminars

In-house seminars of 1 hour duration are conducted on a regular basis by students and faculties

1. “A tale of a virus, mosquito and a bacterium”, Ms Shweta Lankipalli, Biological Sciences Department, Mar 31, 2016. Vote of thanks: Mr X. Shankar.
2. “NIR-Visible Luminescence: Role of Lanthanide doped Upconversion Nanoparticles” Ms. Archana K M, Materials Sciences, March 25, 2016.
3. “The role of flavonoids in mediation of root nodule formation Ms Kavita Keshava Navda, Biological Sciences on Mar 11, 2016.
4. “The Role of Dimension In Microscopic Theory of Magnetism”, Mr. Nepal Banerjee, Theoretical Sciences Department Feb 18, 2016.
5. “Uncertainty and contextuality: Aspects of quantum strangeness”, Dr R. Srikanth, Theoretical Sciences Department Feb 12, 2016.
6. “Non-siliceous functionalized mesoporous oxides as versatile materials for heterogeneous catalysis”, Mr. Manjunathan P, Materials Science Department
   Feb 5, 2016.
7. “Diabetes Medication and Mechanism of action”, Dr. Ananda K, Biological Sciences Department Jan 29, 2016.
8. “Why can't we remember the future?" Mr. S. Aravinda, Theoretical Sciences Department Jan 22, 2016.
9. “2015 Nobel Prize in Chemistry: Mechanistic Studies of DNA Repair”, Dr. Raghurama P Hegde, Biological Sciences Department, Jan 13, 2016.
10. “Relaxor Ferroelectrics: A Unique Class of Smart Materials”, Dr. Sowmya Palimar, Materials Sciences Department, Dec 30, 2015.
11. “Phase transition of high-tc superconductor using renormalization group”, Mr. Nepal, Theoretical Sciences Department, October 27, 2015.
12. “Role of Fungi in Bioremediation”, Kavitha K. N., Biological Sciences Department, September 29, 2015.
13. “From grains to glass”, G. C. Pavithra, Biological Sciences Department, September 15, 2015.
14. "Bifunctional and Multifunctional catalyst for cascade reactions", Sathyapal, Materials Science Department, August 25, 2015.
15. “Photocatalysis: a promising route for 21st century Organic Reaction Transformations”, Pradeep Shanbogh, Materials Science Department, July 19, 2016.
16. “The quantum mechanics of self-replication”, Mr. Aravinda S., Theoretical Sciences Department, May 22, 2015.
17. “The odyssey of Gene Therapy”, Ms. Shwetha Lankipalli, Biolaogical Science Department, April 9, 2015.

Campus life

Independence Day celebration and Vanamahotsava

Independence Day was celebrated at Bidalur campus. Prof. A. B. Halgeri hoisted the national flag in presence of PPISR faculty, staffs and students. In his independence day address, he recalled freedom fighters who sacrificed their lives for the country. He also directed the students and faculty to dedicate themselves for the growth of science. This was followed by planting ofaround 100 saplings inside the PPISR campus.

Saraswati/Ayudha Pooja At the institute

Saraswathi and Ayudhapoojawere performed at the Campus on October 21, 2015. The Director, all thestaff, faculty, students and other PPISRmembers participated enthusiasticallyand paid respect to the Goddess ofknowledge.

Library

The library of PPISR has over 1000 books related to Maths, Physics, Chemistry, Biology, Materials Science and other interdisciplinary subjects, apart from books of general interest, magazines and daily newspapers.

The library also contains a reasonably good collection of Indian and international journals in print and access to a reasonably large number of e-journals. All the books have been barcoded to facilitate online access. The library is accessible at all times, and has internet access. Plans are afoot to provide wiFi access throughout the library. Recently, the library was shifted to the new Biological Science building, to make more reading space available.

Computer and internet facilities

Sufficient computer and internet facility is given to faculty members and students at PPISR. Further, a central computing facility of two GPU-based supercomputers with Intel Xeon 8 core machines with 32 GB RAM each is available. These are outfitted

with multi-core DDR3-based powerful NVidia GPU's for CUDA computing. Internet access is through a dedicated 4 MBPS line provided by Mirconova, our new internet service provider.

Sports facilities

The new hostel at PPISR campus has some of the sports facilities like Cricket ground, Badminton court, Table Tennis and Carrom.

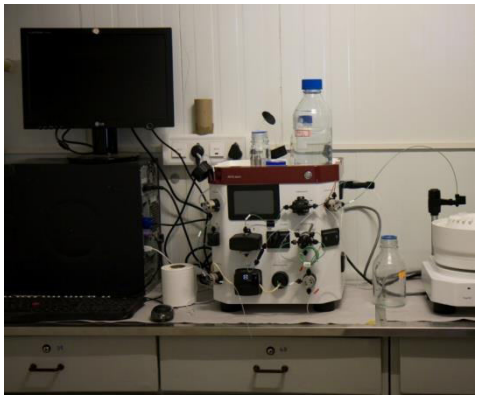
New research facilities 2015-16

Surface area analyzer (Belsorb Mini II, Bel Japan)

Gas Chromatograph (Agilent 7890B)

Gas sensing analyzer

Akta Start FPLC (GE Life Sciences)



Gas Chromatograph (Shimadzu 2014 AF)

Visitors' views

1) **Prof. M N Sudheendra Rao,** Vice Chancellor, Central University of Karnataka.
"Turned out to be an impressive experience. Sure to see the institute seeing higher levels of performance in the near future and make an impact. Young team is on well chosen directions and attract others through their performance. I wish the Director and his team a great time and purpose."

2) **Dr. B M Reddy,** CSIR - IICT, Hyderabad.
"This centre is doing excellent work in various areas including Catalysis, Nano Materials etc., I am very much impressed with their performance. I wish all the best for future activities."

3) **Dr. Bipin Joshi,** Principal Scientific officer, DST, New Delhi.
"I have found a very dedicated team of researchers committed for research. In a span of four years more than 130 publications tells their devotion for research. They need to expand their team towards achieving the objectives lead by His Holiness Sri Swamiji. Best wishes."

4) **Dr. P A Parikh,** Professor, SVNIT, Surat .
"Very cordial and enthusiastic members ofthe institute. Enjoyed the time I spent here and wish to visit again".

5) **Dr. T S Sathyanarayanan,** Vivekananda Institute of Tropical Mycology, Ramakrishna Mission Vivekananda College, Chennai.
"My visit to this Institute has been very informative. I enjoyed discussing with Dr. Ananda and the Director Dr. Halgeri. I am impressed by the research work being carried out in the Dept. of Biological Sciences".

6) **Dr. Vasudeva Siruguri,** UGC-DAE Research, Consortium for Scientific Research, Mumbai Centre, BARC.
"The institute has been a pleasant surprise for me. I was highly impressed by the commitment shown by the faculty for research in spite of being in a small research institute. The research output is of high quality and I am sure the institute would do extremely well in days to come, all with the blessings of Shri Poornaprajna".

7) **Dr. M P Yashodha,** Professor, MIT, Manipal.
"It is great pleasure for me to give a feedback about this institute. It is located at a very calm and quite place. It is a budding institute growing very fast. I wish this institute to all the best and grow to the higher heights".

8) **Dr. KHAVINET LOURVANJI,** *Process Innovation Manager, SCG Chemical Company Limited, Thailand,*
"Impressive campus atmosphere and set up. Interesting research programme with expansive collaboration to industrial firms. Also, with Dr. Halgeri's experience in technology development for industry, these should make PPISR having strength in answering technology needs in commercial world, which is quite important to make research works valuable. Appreciate everyone's hospitality. Thank you very much".

9) **Prof. PANDURANG ASHRIT,** *Universite de Moncton, Canada.*
"I am extremely impressed by the motivation, energy and dedication of all the people involved with PPISR, right from the Director to the students. I have no doubt that the vision of Swamiji will come true. The institute has a great ambiance for high class research. My hat's of to all researchers who are doing great job with modest facilities. My best wishes to PPISR for continued growth and success".

10) **Dr. J P GUPTA,** *Director, Rajiv Gandhi Institute ofPetroleum, Rae Bareli.*
"What a pleasure to visit PPISR! Great beginning, for greater achievements are in store. Your young scientists are full ofenthusiasm and working on exiting problems ofimmense interest. Our best wishes".

11) **Dr. M S REDDY,** *Professor, Department of Biotechnology, Thapar University, Patiala***.**
"The centre is located in a nice place and seems to be best place. I see lot of enthusiasm among the scientists for Research and development. This will excess as the best centre in near future".

12) **Dr. A S PRAKASH,** *Senior Scientist, CSIR, Taramani, Chennai*
"It give s me great pleasure visiting Poornaprajna Institute. I am impressed with the Director's initiative in building state of the art catalytic and materials characterization facilities. The campus is clean, neat and maintained well. The students, faculties are highly enthusiastic. It gives me good impression. I wish all the great future for Poornaprajna Institute".

13) **Dr. V.P.Bhandarkar,** *Thermax Ltd, Pune*
"Fascinated to see the amount of work that is being done. You have an excellent team, highly passionate and working in very diversified areas. Great to see the amount of progress being made in such a short time. Our best wihes".

विद्यया विन्दते अमृतं

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