



Sebastian C. Peter

Professor

*New Chemistry Unit
Jawaharlal Nehru Centre for
Advanced Scientific Research
Bengaluru, India*

Founder & Director
*Breathe Applied Sciences
Pvt. Ltd.
Bengaluru, India*

PROFILE

Research professional in electrochemistry/solid-state chemistry/ material chemistry/ water splitting/ fuel cells/batteries/CO₂ reduction characterization/ designing nanomaterials, application of innovation and product development/technology transfer.

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Editorial Board Member

Journal of the American Chemical Society
Angewandte Chemie International Edition
ChemSusChem
Journal of Solid State Chemistry

Education

Doctor of Philosophy (Chemistry) | University of Münster, Germany
(2003-2006)

Master of Technology (Industrial Catalysis) | Cochin University of Science and Technology, India (2000-2002)

Master of Science (Chemistry) | St. Thomas College, Calicut University, India (1998-2000)

Bachelor of Science | St. Thomas College, Calicut University, India
(1995-1998)

Work Experience

Professor | Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India (2022-Till date)

Associate Professor | Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India (2017-2022)

Assistant Professor | Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India (2014-2017)

Ramanujan Fellow | Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India (2010-2014)

Post-doctoral Fellow | Northwestern University, USA (2008-2010)

Post-doctoral Fellow | Max Plank Institute for Chemical Physics of Solids, Dresden, Germany (2007-2008)

Fundamental Research

- Design and discovery of Inorganic Solid-State Materials for Energy and Environmental applications
- CO₂ Capture and Utilization (Thermochemical, Photochemical and electrochemical)
- Non-noble metal-based alloys, intermetallics, chalcogenides and oxides for Water Splitting/Hydrogen evolution/ Oxygen production
- Development of non-Pt based catalysts as efficient electrodes in Fuel Cells

Translational Research

- Co-Founder and Director of the start-up **Breathe Applied Sciences Pvt. Ltd.**
- Translation of laboratory scale conversion of CO₂ to chemicals/fuels (5 kg CO₂/day) to pilot scale (300 kg CO₂/day) and commercial scale (above 1 TPD).
- Commissioning first ever CO₂ to methanol plant in India at coal power plant in SCCL, Telangana.
- Integrated technology development in Carbon Capture and Utilization (CCU).
- Scaling up of catalyst synthesis from 1 gram to 5 kg capacity.
- Life Cycle Analysis on CO₂ to methanol – Carbon Negative technology.
- ISO14034 Certificate for the pilot scale CO₂ to methanol process.

Fellowship

Royal Society of Chemistry (RSC)
International Association of Advanced
Materials (IAAM)
Indian National Academy of Young Scientists
(INYAS)

Membership

American Chemical Society
Royal Society of Chemistry
Chemical Research Society of India
Material Research Society of India
American Society of Metals International
Society for Material Chemistry, India

Guidance of students

PhD degree: 18 (10 completed, 9 ongoing)
MS: 6 (5 completed, 2 ongoing)
Post-Doctoral: 33 (26 completed, 8 ongoing)
R&D students: 42 (38 completed, 6 ongoing)
Undergraduates: 51
Visiting Scientists: 12

Teaching

- **At under-graduate level:**
Course 1. Basic solid state chemistry (2011-to date)
- **At graduate level**
Course 1. Crystallography of solid state materials (JNC-310, 2011-to date, 3 credits)
Course 2. Solid State NMR/XPS/Mossbauer Spectroscopy in Physical methods for chemists (JNC-305, 2011-to date, 3 Credits)
Course 3. Chemical laboratory for Int-PhD students (JNC-203, 0.4 Credit)

Industry Collaborators

- **Bharat Petroleum Corporation Limited**
- **Coal India Limited**
- **Unilever**
- **Shell**
- **Tata Steel**
- **Singareni Collieries Company Limited**
- **Sud-Chemie**

Selected Publications (last 2 years)

- (1) Tweaking Photo CO₂ Reduction by Altering Lewis Acidic Sites in Metalated-Porous Organic Polymer for Adjustable H₂/CO Ratio in Syngas Production. Paul, R. Das, N. Das, S. Chakraborty, C-W. Pao, Q-T. Trinh, G. T. K. K. Gunassoriya, J. Mondal, *Angew. Chem. Int. Edn.* 2023, DOI:https://doi.org/10.1002/anie.202311304. (Impact Factor: 16.82)
- (2) Selective Metal-Free CO₂ Photoreduction in Water Using Porous Nanostructures with Internal Molecular Free Volume. S. Mohata, R. Das, K. Koner, S. Chakraborty, Y. Ogaeri, Y. Nishiyama, S. C. Peter, R. Banerjee, *J. Am. Chem. Soc.* 2023, 145, 23802-23813. (Impact Factor: 16.383).
- (3) Distortion-Induced Interfacial Charge Transfer at Single Cobalt Atom Secured on Ordered Intermetallic Surface Enhances Pure Oxygen Production. Mondal, S.; Riyaz, M.; Bagchi, D.; Dutta, N.; Singh, A. K.; Vinod, C. P.; Peter, S. C. *ACS Nano* 2023, 17, 22, 23169–23180. (Impact factor: 18.027).
- (4) Cobalt-Induced Phase Transformation of Ni₃Ga₄ Generates Chiral Intermetallic Co₃Ni₃Ga₈. Singh, A. K.; Wang, Wu.; Panda, D. P.; Bagchi, D.; Goud, D.; Ray, B.; He, J.; Peter, S. C. *J. Am. Chem. Soc.* 2023, 145, 1443-1440. (Impact Factor: 16.383).
- (5) Engineering Charge Density on In_{2.77}S₄/Porous Organic Polymer Hybrid Photocatalyst for CO₂ to Ethylene Formation Reaction. Das, R.; Paul, R.; Parui, A.; Shrotri, A.; Atzori, C.; Lomachenko, K. A.; Singh, A. K.; Mondal, J.; Peter, S. C. *J. Am. Chem. Soc.* 2023, 145, 422–435. (Impact Factor: 16.383)
- (6) In-situ Surface Reconstruction Upon Aliovalent Substitution in ZnS Leads to CuGaS₂ Boost Selective Conversion of CO₂ to Ethylene. Chakraborty, S.; Das, R.; Das, K.; Singh, A. K.; Bagchi, D.; Vinod, C. P.; Peter, S. C. *Angew. Chem. Int. Edn.* 2023, 62, e202216613. (Impact Factor: 16.82)
- (7) Intrinsic Charge Polarization in Bi₁₉S₂₇Cl₃ Nano Roads Promotes Selective C-C Coupling Reaction During Photoreduction of CO₂ to Ethanol. Das, K.; Das, R.; Riyaz, M.; Parui, A.; Bagchi, D.; Singh, A. K.; Singh, A. K.; Vinod, C. P.; Peter, S. C. *Adv. Mater.* 2023, 35, 2205994. (Impact Factor: 32.086)
- (8) *In-Situ* Mechanistic Insights for Oxygen Reduction Reaction in Chemically Modulated Ordered Intermetallic Catalyst Promoting Complete Electron Transfer. Mondal, S.; Bagchi, D.; Sarkar, S.; Singh, A. K.; Vinod, C. P.; Peter, S. C. *J. Am. Chem. Soc.* 2022, 44, 11859–11869 (Impact Factor: 16.383).
- (9) Morphology Tuned Pt₃Ge Accelerates Water Dissociation to Industrial Standard Hydrogen Production over a wide pH Range. Mondal, S.; Sarkar, S.; Bagchi, D.; Das, T.; Das, R.; Singh, A. K.; Prasanna, P. K.; Vinod, C. P.; Chakraborty, S.; Peter, S. C. *Adv. Mater.* 2022, 34, 2202294. (Impact Factor: 32.086)
- (10) Potential and Time Dependent Dynamic Nature of Oxide-derived PdIn Nanocatalyst During Electrochemical CO₂ Reduction. Bagchi, D.; Sarkar, S.; Singh, A. K.; Vinod, C. P.; Peter, S. C. *ACS Nano* 2022, 16, 4, 6185–6196. (Impact factor: 18.027)
- (11) Green Transformation of CO₂ to Ethanol using Water and Sunlight by Cooperative Endeavour of Naturally Abundant Red Phosphorus and Bi₂MoO₆. Das, R.; Das, R.; Ray, B.; Vinod, C. P.; Peter, S. C. *Energy & Environ. Sci.* 2022, 15, 1967-1976. (Impact Factor: 39.714)
- (12) Structure-Tailored Surface Oxide on Cu-Ga Intermetallics Enhances CO₂ Reduction Selectivity to Methanol at Ultra-Low Potential. Bagchi, D.; Raj, J.; Singh, A. K.; Cherevotan, A.; Roy, S.; Manoj, K. S.; Vinod, C. P.; Peter, S. C., *Adv. Mater.* 2022, 34, 2109426 (Impact Factor: 32.086)
- (13) Operando Generated Ordered Heterogeneous Catalyst for the Selective Conversion of CO₂ to Methanol. Cherevotan, A.; Raj, J.; Dheer, L.; Roy, S.; Sarkar, S.; Das, R.; Vinod, C. P.; Xu, S.; Wells, P.; Waghmare, U. V.; Peter, S. C. *ACS Energy Lett.*, 2021, 6, 509-516. (Impact Factor: 23.991)
- (14) Systematic Assessment of Solvent Selection in Photocatalytic CO₂ Reduction. Das, R.; Chakraborty, S.; Peter, S.C. *ACS Energy Lett.*, 2021, 6, 3270–3274. (Impact Factor: 23.991).

Selected Patents

- Methods and compositions for the detection of X-ray and γ -ray radiation, US Patent, **(2012), US 8,519,347 B2.**
- A Method of Synthesizing Intermetallic Compounds and Applications Thereof, **(2019) WO2015011680A1.**
- Shape tailored ordered PdCu₃ nanoparticle surpassing the activity of state-of-the-art fuel cell catalyst. **(2021), 380514**
- Palladium Based Selenides as Highly Stable and Durable Cathode Materials In Fuel Cell for Green Energy Production. **(2021), 373323**
- Catalyst, its process of preparation, and applications towards reduction of carbon dioxide to chemicals. **INDIAN Application No. PCT/IN2019/050873. US Patent, US No. 17/298,378. Europe No.19832739.70.**
- A Catalyst, Its Application in Production of Hydrogen. **Provisional Application No. 202141037359.**
- A Catalyst for Thermochemical Reduction of CO₂, **Provisional Application No. 202241001975. PCT/IN2023/050037**
- Pd based catalyst and Implementations Thereof, **Provisional Application No.202241007999.**

Selected Invited Talks

- **AsiaNANO 2022.** Asian Conference on Nanoscience & Nanotechnology, Busan, Korea (9th November 2022)
- Journey of Breathe in translating Economical de-Carbonization from Science to Technology. Invited talk at National Science Day 2021, JNCASR, Bengaluru (28th February 2021)
- SUNtoX, Solar Energy for Carbon Free Liquid Fuel, Mission Innovation, IC5 (29th July 2021)
- Keynote lecture at RAiSE 2021 organized by IIT Madras (2-4th December 2021)
- Plenary talk at Webinar on "Catalysis: From Life to Livelihood", Ramanujan Institute for Basic Sciences, Kerala State Council for Science, Technology and Environment, Govt of Kerala (10th August 2020)
- The Boon of CO₂: Carbon Negative Approach from an Academic Entrepreneur. Plenary talk at E-Summit 2020, IIT Bombay (1-2nd February 2020)
- 10th International Conference on Materials for Advanced Technologies (ICMAT-2019), Singapore (24-29th July 2019)
- Tenth annual International Workshop on Advanced Materials (IWAM 2018), Ras Al Khaimah, UAE (18-20th Feb 2018)
- 251st ACS Meeting, San Diego, USA (13-16th March 2016)
- Gordon Conference on Solid State Chemistry, New London, NH, USA (27-31th July 2014)
- 41st International Conference on Coordination Chemistry (ICCC-41), Singapore (21-25th July 2014)

Selected Meetings

- International Conference in Asia – 2022 (IUMRS-ICA 2022), IIT Jodhpur (19-23th December, 2022)
- KIOSK at the Sustainable Innovation Lounge/Award Lecture, KPMG ENRich 2021 (8th December 2021)
- Catalysis in Energy & Environment Fuel Cell, Water Splitting and CO₂ Capture & Utilization. Invited talk at Vaibhav Summit (15th October 2020)
- 10th International Conference on Materials for Advanced Technologies at Singapore (24-29th July 2019)
- Asian Development Bank at Asian Clean Energy Forum 2019 at Manila, Philippines (17-21st June 2019)
- CleanEquity Monaco, Business Meet (12-15th March 2019)
- "European Methanol Summit" at Dusseldorf, Germany(13-14th November 2018)
- CO₂ to methanol translational research at Infosys, Bengaluru (22nd May 2018)
- NRG COSIA Carbon XPRIZE finalist announcement talk at New York (8-9th April 2018)
- Carbon XPRIZE Team Summit, in New York, USA (12-13th June 2017)

AWARDS/RECOGNITIONS

National:

- MRSI Materials Science Annual Prize' (2023)
- Winner of Materials Next 4.0 hosted by Tata Steel (2023)
- National Prize for Research in Environmental Chemistry, including CO₂ Reduction and Green Hydrogen (2022)
- SMC Bronze medal (2022)
- Listed in "75 under 50 scientists shaping today's India" released by DST, India (2021)
- Indian National Academy of Engineering (INAE) young Innovator and Entrepreneur Award (2021)
- Winner of KPMG ENRich21 under the concept low carbon world (2021)
- Technology National Award for CO₂ to methanol pilot plant development by Technology Development Board, DST (2021)
- Chemical Research Society of India (CRSI) Bronze Medal (2020)
- DST Swarnajayanti Fellowship (2018)
- Elevate 100 from Karnataka State Government (2017)
- Materials Research Society of India (MRSI) medal (2016)
- Ramanujan Fellowship, DST, India (2010-2014)

International:

- Selected as a fellow of the Royal Society in the category of the leaders in the field CO₂ reduction, hydrogen production and fuel cell.
- J C Bose Diamond Jubilee Lecture Award by IAAM (2022)
- IAAM Fellow (2022)
- Sheikh Saqr Career Award Fellowship (2022)
- Led the team "Breathe Applied Sciences Pvt Ltd" enters into the final round of NRG COSIA carbon XPRIZE global competition prize worth 20M USD. BREATHE is the only team from India which entered in the final round among a total of 10 teams. (2016-2021)
- Best Runner up in upcoming Environmental technology (CO₂ to methanol) by CleanEquity Monaco (2019)
- Emerging Investigator by Royal Chemistry Society (RSC) (2016)
- Emerging Young Investigator in the field of solid-state chemistry by the American Chemical Society (2014)
- Emerging Investigator in Material Science by Institute of Physics (IOP) (2016)
- Editorial board member of Journal of Solid State Chemistry (Since 2016 December)
- Member of the Royal Society of Chemistry (MRSC)-2016
- Int. Graduate School of Chemistry fellowship, University of Münster, Germany (2003-06).

Technologies Developed/Transferred

- Generated 11 patents in the area of new materials, fuel cells and CO₂ reduction.
- Developed an integrated solution for the conversion of anthropogenic (waste) CO₂ into methanol, dimethylether, methane and other value-added products.
- Founded a Start-up venture "Breathe Applied Sciences Pvt Ltd" having the mission of converting waste CO₂ into fuels and chemicals.
- Led the team BREATHE Applied Sciences Pvt Ltd in the NRG COSIA carbon XPRIZE global competition prize worth 20M USD on the subject Carbon utilization and entered into the final round. BREATHE is the only team from India in the final round of the competition.
- Developed a facility to convert 300 kg CO₂/day to methanol at JNCASR.
- Constructing first pilot plant from Coal flue gas to methanol at Singareni Collieries Company Limited, Telangana
- Breathe has been awarded as one of the top 100 start-ups by Karnataka State Government through a programme called ELEVATE 100 in 2017.
- Developed non-Pt based catalysts as efficient electrode materials with activity and durability on par with the state-of-the-art material Pt/C for fuel cells.
- Developed single cell fuel cell (PEM, DMFC and FAFC) station facility at JNCASR