SUMAN RAY

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EDUCATION

2007-2009	University of Calcutta, Rajabazar Science College, Kolkata. M.Sc. in Chemistry (Organic specialization) with 79.6% marks, 2009.
2004-2007	Scottish Church College, Kolkata (University of Calcutta). B.Sc. Honours in Chemistry with 69.9% marks, 2007.
2002 -2004	W. B. C. H. S. E. Higher Secondary (2004) with 81.4% marks.
2002	W.B. B. S. E. Secondary (2002) with 83.0% marks.

AWARDS & FELLOWSHIP:

Dr. D S Kothari Post doctoral Fellowship in Chemistry (UGC), Govt. of India, 2014

Junior Research Fellow, National Eligibility Test (NET), Govt. of India, 2008 and 2009.

Graduate Aptitude Test in Engineering (GATE), Govt. of India, 2009.

Qualified IIT-Joint Admission Test (IIT-JAM), Govt. of India, 2007.

POSITIONS HELD:

1) Senior Research Fellow (CSIR), Department of Chemistry, University of Calcutta, from September, 2011 to October 2014.

2) Junior Research Fellow (CSIR), Department of Chemistry, University of Calcutta, from August, 2009 to August 2011.

PROFESSIONAL EXPERIENCE:

Post-doctoral Fellow (2^{nd} February 2015 – 28^{th} September 2018) in Solid State and Structural Chemistry Unit, Indian Institute of Science, Bangalore.

EMPLOYMENT DETAILS:

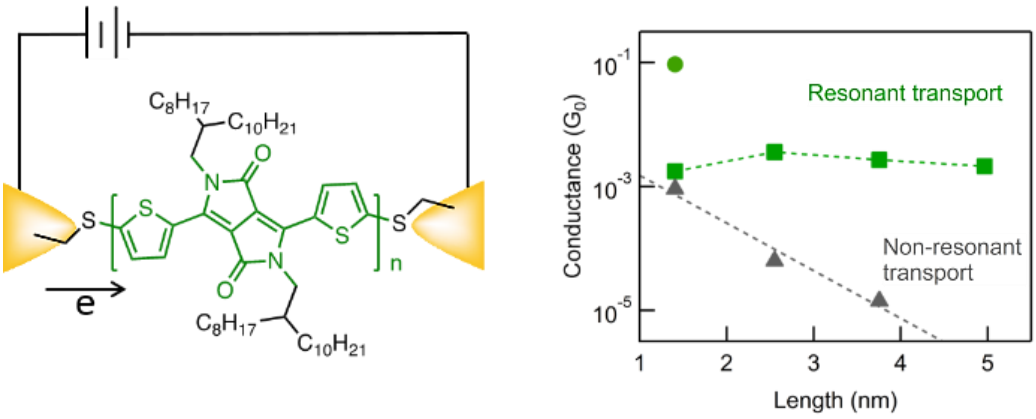
Assistant Professor, Department of Chemistry, Presidency University, Kolkata, India. (1^{st} October, 2018 to till date)

RESEARCH INTERESTS:

1) **Single molecule conductance measurement of *organic molecular wire* through Scanning Tunneling Microscope break junction (STM-BJ) technique**:

Since the birth of the solid state transistor more than sixty years ago, extensive effort has been invested into miniaturizing circuit components. This was due to the growing demand for fast, energy efficient, and cheap methods to compute and store immense amount of data information. Current silicon-based technology has imposed a boundary on transistor size of approximately 4 nm. A molecule, being the tiniest part of any given material is the smallest functional constituent out of which a device can be fabricated. However, an imperative factor in implementing (single) molecule in electronic circuits is the optimization of their structures toward preferred functionalities and a reliable technique of equipping them into a nanoscale junction. This necessitates a comprehensive understanding of the relationship between electronic structure and conductivity. Therefore, the idea of using single-molecule junctions, individual molecules attached with macroscopic metal electrodes, for characterizing the building units that create macromolecules is fundamental to the advancement of functional nanosized devices. The STM-BJ technique provides access to probe the fundamental electronic properties at the single-molecule level, independent of the effect arising in bulk. **Therefore, one of my current research interests is to synthesize organic molecular wire for single molecule conductance measurement**.

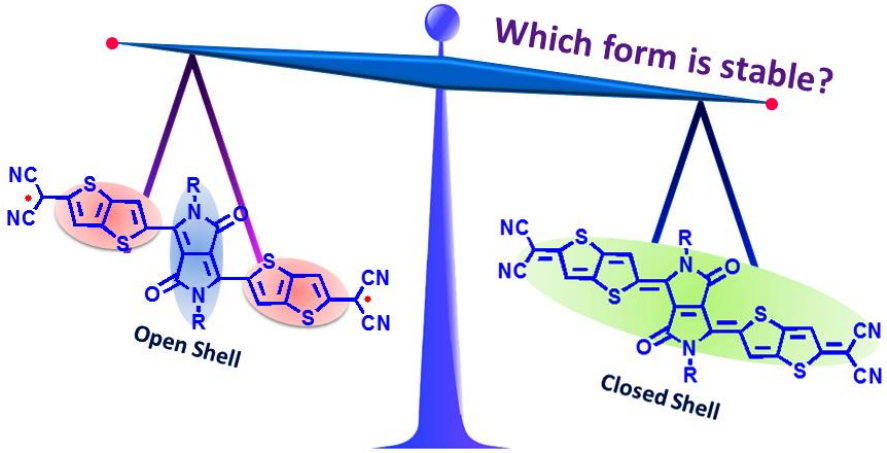
Journal of the American Chemical Society, 2018, 140, 13167–13170.



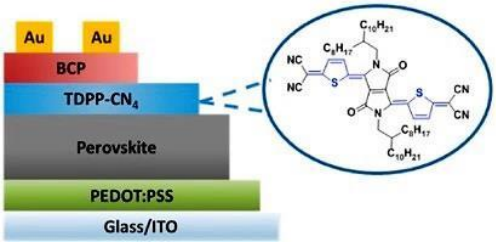
2) ***Organic biradical and polyradical*; synthesis, exploration of properties and applications**:

π-conjugated donor-acceptor quinoidal molecules exemplify the concept of functional materials, owing to their inimitable properties such as exceptionally high electron affinities, amphoteric redox character, near-infrared (NIR) absorption features driven by reduced HOMO-LUMO energy gap and open-shell diradical character; quite unusual for pure, neutral organic compounds. These privileged molecules with biradical character have many prospective applications for organic electronics, photonics, and organic spintronics. The diradical character index (y_0) and singlet–triplet energy gap (ΔE_{S-T}) are two imperative factors that can be related to the magnetic property of open-shell singlet biradicaloids. However, quinoidal molecules with large diradical character are generally unstable which renders the synthesis of more extended quinoidal oligomeric arrangement a big challenge. **Therefore, my objective is to synthesize stable π-conjugated donor-acceptor molecules with large biradical character.**

J. Phys. Chem. C, 2017, 121, 16088-16097.



Solar Energy, 2019, 186, 9-16.

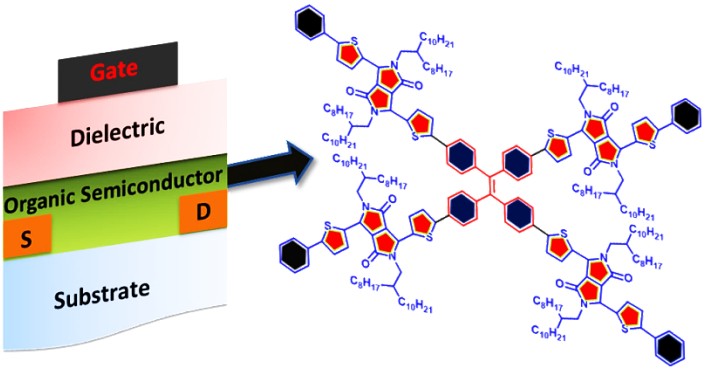


3) **Star shaped *organic small molecules and 2D-polymers* for Organic Field Effect Transistor (OFET)**:

Recently, semiconducting oligomer- and polymer-based FETs have demonstrated high charge carrier mobilities suitable for commercial application. However, most of the π-conjugated small molecules and polymers are linear (1D) chains showing efficient movement of charge carriers and excitons along the direction of the polymer chain. Again, the total electronic characteristic is determined by both intra- and inter-chain charge transports. Since most of the linear molecules exhibit restricted lateral overlap between "slim" backbones, even in the face-to-face mode, the rate of charge transport in the two other directions is slowed down. This results in anisotropy in carrier transport, which is in sharp disparity to the silicon, which shows 3D transport features. Since the problem stems from the linearity of the semiconductor systems, the design of star shaped systems having conjugation in two perpendicular directions, may be expected to give a possible "chemical" solution to the problem. **I have synthesized several star shaped oligomers and 2D polymers to**

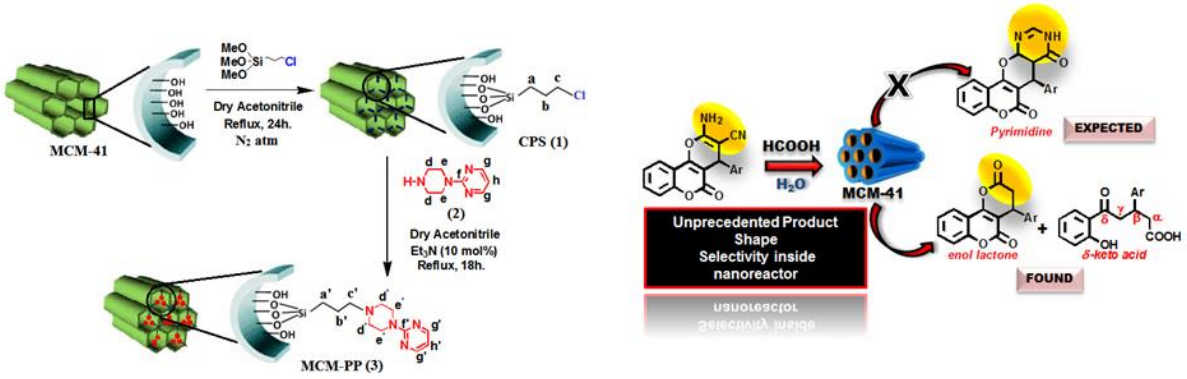
address this problem. Some of them show promising carrier transport mobility in OFET devices.

ACS Applied Electronic Materials, 2019, doi.org/10.1021/acsaelm.9b00427***.***



4) **Heterogeneous catalysts for Green and Sustainable synthesis:**

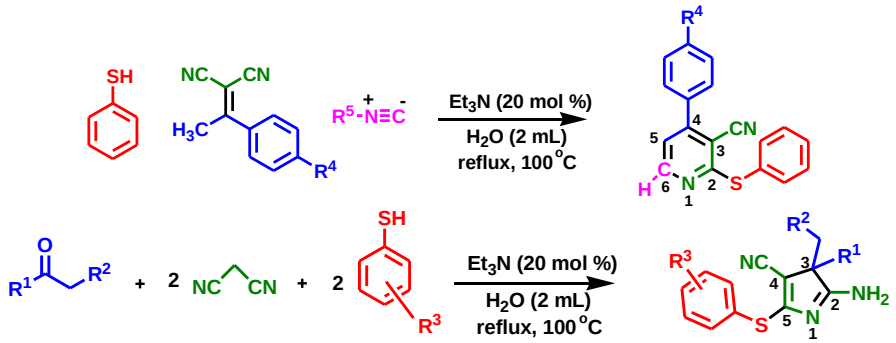
Recently, the field of green chemistry has witnessed an explosive development in terms of global environmental concerns. Therefore the concept of “green catalysis”, which makes catalysis science even more creative, has become an essential part of sustainability. Green catalysis emphasizes carrying out catalytic reactions through the use of heterogeneous catalysts in green solvents, preferably in water. So design of new heterogeneous catalysts and their application in multicomponent organic synthesis in eco-friendly solvents is a very interesting research problem which I am currently exploring.



5) **Organocatalytic synthesis of N-containing heterocycles in aqueous medium:**

3*H*-pyrrole is a little known ring system with a potentially rich chemistry. This approach to 3*H*-pyrroles offered an unprecedented coupling which led to the construction of the nitrogen containing ring without starting from any amine moiety in water using triethylamine as catalyst. Here the dual role of CN moiety (both as a carbon centre nucleophile and an electrophile) is exploited for this synthesis.
Moreover, the same methodology had been extended for the synthesis of pyridine-3-carbonitrile derivatives. The formation of pyridine products occurred via an unusual mechanism which depicted the incorporation of only one carbon atom from isocyanide into pyridine.

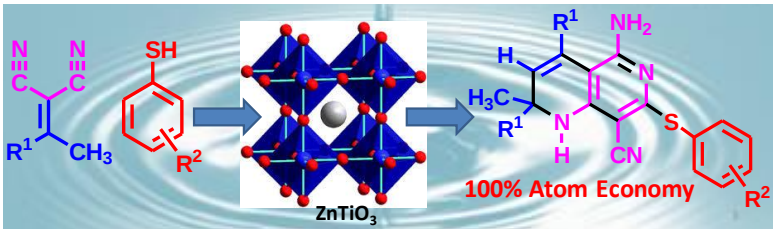
Organic Letters, 2013, 15, 5622



6) **Mixed metal oxide nanoparticle synthesis and applications in Multicomponent Reaction:**

Mixed-metal oxide nanoparticles (MMONs) as cutting-edge nanocatalysts have attracted much interest in recent years and are actively pursued in a variety of organic transformations and greener reaction protocols. These MMONs are robust, high-surface-area heterogeneous catalysts and have enormous potential to rival or even surpass the performance of their bulk counterparts. Remarkably, the mixed-metal oxide nanoparticles have greater catalytic activity than the individual component oxides because of their enhanced active acidic and basic sites along with increased surface area. Furthermore, the mixed oxide systems adopt structures in combination with properties that an individual oxide cannot achieve. Therefore, synthesis of MMONs and their application in various catalytic transformations is another field of my research.

ChemPlusChem, 2015, 80, 731



7) **Transition metals and precious metals incorporated within silica network for oxidation purpose.**
Catalysis Communications, 2015, 58, 97-102

PUBLICATION DETAILS:

Submitted and Under Preparation Muniscripts

1) "Molecular length, aromaticity and nature of conducting orbital dictates conductivity "
To be Submitted.

Selected Publications

2021

1) "Voltage-Induced Single-Molecule Junction Planarization"
Yaping Zhang, E-Dean Fung, Tianren Fu, **Suman Ray**, Marc H. Garner, Anders Borges, Michael L. Steigerwald, Satish Patil, Gemma Solomon*, Latha Venkataraman*
Nano Letters, 2021, 21, 673–679.
(Impact Factor **11.283**)

2) "Diastereoselective trans Cyclopropanation of 3-alkylidene oxindoles with in situ generated α-

diazocarbonyls or α,β-unsaturated diazo compounds"
Sayan Pramanik, **Suman Ray**, Suvendu Maity, Prasanta Ghosh, Chhanda Mukhopadhyay*
Synthesis, 2021, DOI: 10.1055/a-1384-1967.
(Impact Factor **2.675**)

2020

3) "Giant Photoconductance and Fermi Level Pinning induced by doping in Air Stable N-type Organic Semiconductor"
Shikha Sharma, Samrat Ghosh, Tanweer Ahmed, **Suman Ray**, Saurav Islam, Ulrike Salzner, Arindam Ghosh, Shu Seki, Satish Patil*
ACS Applied Electronics Materials, 2020, 2, 66-73.

4) "First report of isocyanide as reducing agent for the reduction of 1,6-naphthyridines"
Paramita Das*, **Suman Ray**, Rupak Saha and Chhanda Mukhopadhyay*****
ChemistrySelect, 2020, 5, 3581-3585.

2019

5) "Ambipolar Charge Transport in Tetraphenylethylene-Diketopyrrolopyrrole Semiconductors"
Suman Ray, Julianna Panidi, Tushita Mukhopadhyay, Ulrike Salzner, Thomas Anthopoulos, Satish Patil*,
ACS Applied Electronics Materials, 2019, 1, 2037-2046.

6) "UV-Ozone Modified Sol-Gel Processed ZnO for Improved Diketopyrrolopyrrole-Based Hybrid Photodetectors"
Alec Pickett, Aiswarya A. Mohapatra, **Suman Ray**, Christopher Robledo, Kartik Ghosh, Satish Patil, and Suchismita Guha.
ACS Applied Electronics Materials*,* 2019; doi.org/10.1021/acsaelm.9b00597.

7) "Air Stable Diketopyrrolopyrrole-based Electron Transport Layer for Inverted Perovskite Solar Cells"
Shikha Sharma, Nobuya Sakai, **Suman Ray**, Henry Snaith, Satyaprasad Senanayak, Henning Sirringhaus, Henry Snaith, Satish Patil*,
Solar Energy, 2019, 186, 9-16.
(Impact Factor **4.374**)

8) "Interfacial Effects of UV-Ozone Treated Sol-Gel Processable ZnO for Hybrid Photodetectors and Thin Film Transistors"
Alec Pickett, Aiswarya A. Mohapatra, **Suman Ray**, Christopher Robledo, Kartik Ghosh, Satish Patil, and Suchismita Guha.
MRS Advances (Cambridge Core), 2019, 1-8; doi:10.1557/adv.2019.298.

9) "Diketopyrrolopyrrole Based Derivative for Non-Aqueous Redox Flow Battery"
Shikha Sharma, Rathod Suman, **Suman Ray**, Nagaphani Aetukuri, Ashok Kumar Shukla and Satish Patil*****,
The Electrochemical Society (ECS) Meeting Abstracts, **2019, MA2019-01 449**

2018

10) "**Resonant Transport in Single-Diketopyrrolopyrrole Junctions** "
Yaping Zhang[$], **Suman Ray**[$], E-Dean Fung, Anders Borges, Marc H. Garner, Michael L. Steigerwald, Gemma Solomon*, Satish Patil*, Latha Venkataraman*.
Journal of the American Chemical Society*,* 2018, 140, 13167–13170.
(Impact Factor **14.357**)

[$]These two authors contributed equally.

11) "A Serendipitous Observation of Liquid Phase Size Selectivity inside Mesoporous Silica Nanoreactor in the Reaction of Chromene with Formic Acid"
Paramita Das, **Suman Ray**, Piyali Bhanja, Asim Bhaumik and Chhanda Mukhopadhyay*, ***ChemCatChem***, 2018, 10, 2260-2270.
(Impact Factor **4.803**)

2017

12) "Synthesis and characterization of quinoidal Diketopyrrolopyrrole derivatives with exceptionally high electron affinities"
Suman Ray, Shikha Sharma, Ulrike Salzner and Satish Patil*, ***J. Phys. Chem. C***, 2017, 121, 16088-16097.
(Impact Factor **4.536**)

Before 2017

13) "A new MCM-41 supported HPF_6 catalyst for the library synthesis of highly substituted 1,4-dihydropyridines and oxidation to pyridines: report of one-dimensional packing towards LMSOMs and studies on their photophysical properties"
Suman Ray, Mike Brown, Asim Bhaumik, Arghya Dutta and Chhanda Mukhopadhyay*, ***Green Chemistry***, 2013, *15*, 1910.
(Impact Factor **9.125**, ISSN: 1463-9262)

14) "Exploitation of Dual Character of CN Moiety in the Synthesis of Uniquely Decorated 3H-Pyrroles: A Rare Observation"
Paramita Das, **Suman Ray**, and Chhanda Mukhopadhyay*, ***Organic Letters***, 2013, 15, 5622.
(Impact Factor **6.364**, ISSN: 1523-7060)

15) "Synthesis of 2-amino-5-alkylidenethiazol-4-ones from ketones, rhodanine and amines with the aid of re-usable heterogeneous silica-pyridine based catalyst"
Chhanda Mukhopadhyay*, **Suman Ray**, ***Tetrahedron***, 2011, 67, 7936.
(Impact Factor **2.379**, ISSN: 0040-4020)

16) "Rapid and straightforward one-pot expeditious synthesis of 2-amino-5-alkylidene-thiazol-4-ones at room temperature"
Chhanda Mukhopadhyay*, **Suman Ray**, ***Tetrahedron Letters***, 2011, 52, 6431.
(Impact Factor **2.286**, ISSN: 0040-4039)

17) "Copper incorporated nanorod like mesoporous silica for one pot aerobic oxidative synthesis of pyridines"
Suman Ray, Biplab Banerjee, Asim Bhaumik* and Chhanda Mukhopadhyay*, ***Catalysis Communications***, 2015, 58, 97-102.
(Impact Factor **3.699**, ISSN: 1566-7367)

18) "Cubic perovskite $ZnTiO_3$ nanopowder as a recyclable heterogeneous catalyst for multicomponent synthesis of 1,6-Naphthyridine and pyridines in water"
Suman Ray, Paramita Das, Asim Bhaumik and Chhanda Mukhopadhyay*, ***ChemPlusChem***, 2015, 80, 731.
(**3.026**, ISSN: 2192-6506).

19) "Piperazinylpyrimidine modified MCM-41 for the ecofriendly synthesis of benzothiazoles by the simple cleavage of disulfide in the presence of molecular O_2"
Suman Ray, Paramita Das, Biplab Banerjee, Asim Bhaumik and Chhanda Mukhopadhyay*, ***RSC Advances*****,** 2015, 5, 72745.
(Impact Factor **3.840**, ISSN: 2046-2069).

Meeting abstracts and conference papers:

1) "Resonant tunneling transport in single-molecule junctions"
Yaping Zhang, **Suman Ray**, E-Dean Fung, Anders Borges, Marc H. Garner, Michael L. Steigerwald, Gemma Solomon*, Satish Patil*, Latha Venkataraman,
In *ABSTRACTS OF PAPERS OF THE* ***AMERICAN CHEMICAL SOCIETY***, 2018, (Vol. 255). 1155 16TH ST, NW, WASHINGTON, DC 20036 USA: AMER CHEMICAL SOC.

Worked in collaboration with:

1. Prof. Latha Venkataraman
Department of Applied Physics,
Columbia University, New York, NY, U.S.A.

2. Prof. Gemma Solomon
Nano-Science Center and Department of Chemistry,
University of Copenhagen, Copenhagen Ø, Denmark

3. Prof. Thomas Anthopoulos
Department of Physics and Centre for Plastic Electronics, Blackett Laboratory,
Imperial College London, London SW7 2AZ, United Kingdom

4. Prof. Asim Bhaumik
Department of Materials Science
Indian Association for the Cultivation of Science
Jadavpur, Kolkata 700 032 (India)

5. Ulrike Salzner
Department of Chemistry,
Bilkent University, Ankara 06800, Turkey

Instruments Handled:

1) UV-vis spectrometer
2) Instrument for fluorescence, life time and quantum yield measurements
3) X-Ray single crystal diffractometer
4) Spin coater
5) Cyclic Voltammeter
6) Atomic Force Microscopy
7) NMR

Chemistry Softwares known:

1) APEX (X-Ray single crystal data analysis)
2) Shell-X (X-Ray single crystal data Refinement)
3) Mercury

4) Mestrenova (NMR data analysis)
5) Topspin (NMR data analysis)
6) Gaussian
7) Origin
8) Chem Draw
9) Ortep
10) Diamond

RESEARCH SCHOOL/ WORKSHOP/CONFERENCE ATTENDED :

1) Attended the Indo-German Workshop on Renewable Energy (Organic Solar Cells) and Curriculum Innovation in Science Education held on December 1-2, **2015** at Indian Institute of Science, Bangalore.

2) Attended the ACS on Campus event at Indian Institute of Science, Bangalore on January 27, **2016**.

3) Delivered oral presentation on "A new MCM-41 supported HPF6 catalyst for the library synthesis of highly substituted 1,4-dihydropyridines and oxidation to pyridines: report of one-dimensional packing towards LMSOMs and studies on their photophysical properties" at the Acharya Prafulla Chandra Ray Memorial Symposium on Chemistry and Industry (**2013**) organized by the Indian Chemical Society during August 02-03, **2013**.

4) International Symposium on "Recent Trends in 21st Century Organic Chemistry" during December 10-12, **2009**, at the Indian Association for the Cultivation of Science, Jadavpur, Kolkata-700032, West Bengal, India.

5) International Symposium on "Facets Of Weak Interactions In Chemistry" during January 13-15, **2011,** organized by the Department of Chemistry, University of Calcutta, Kolkata, India.

6) International Symposium on "Molecular Organization And Complexity: A Chemical Perspective" during February 6-8, **2013** organized by the Department of Chemistry, University of Calcutta, Kolkata, India.