

## Curriculum Vitae

**SOUMYA MUKHERJEE**

C/o – Dr. Sanjib Das  
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### **Permanent Address:**

3/E-Mahananda Tower, Sonar Bangla Complex,  
Arrah, Shivtala, Durgapur, Paschim Burdwan  
West Bengal, India.

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**Objective:** To pursue a research and development career that requires best analytical skills and utilizes my professional expertise to the optimum level to explore science. Such an opportunity will not only give my career a head start but also enrich me professionally.

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### **Academic Qualifications:**

- **Ph.D. in Chemistry (2013-2019)**  
Academy of Scientific and Innovative Research (AcSIR)  
CSIR-Institute of Minerals and Materials Technology, Bhubaneswar, Odisha, India.  
**CGPA:** 9.64/10, First Class (Ph.D. Course work)  
**Thesis Title:** Synthesis of Nanoporous Organic and Metal-Organic Polymer based Adsorbents for Gas Storage/Separation and Environmental Remediation.  
**Thesis Supervisor:** Dr. Sanjib Das
- **M.Sc. in Chemistry (2009-2011)**  
Department of Applied Chemistry  
IIT (Indian School of Mines) Dhanbad, Jharkhand, India.  
**CGPA:** 8.35/10, First Class
- **B.Sc. in Chemistry (2005-2009)**  
Department of Chemistry  
Durgapur Government College, Burdwan University, Burdwan, West Bengal, India.  
**Percentage/Class:** 54 Percent, Second Class
- **Higher Secondary (2003-2005)**  
West Bengal Council of Higher Secondary Education, India.  
**Percentage/Class:** 74.8 Percent, First Class
- **Secondary (2003)**  
West Bengal Board of Secondary Education, India.  
**Percentage/Class:** 84.8 Percent, First Class

### **Project Research Experiences:**

- **M.Sc. 1<sup>st</sup> year Winter Project (18/05/2010 – 10/07/2010)**  
Department of Chemistry  
Birla Institute of Technology (BIT), Mesra, Ranchi, Jharkhand, India.  
**Project Title:** Synthesis and Functional Group Transformation of 2-Pyranone.  
**Project Supervisor:** Dr. Ashoke Sharon

- **M.Sc. 2<sup>nd</sup> year Summer Project (01/11/2010 – 30/04/2011)**  
 Department of Applied Chemistry  
 IIT(Indian School of Mines) Dhanbad, India.  
**Project Title:** Sodium Trifluoromethanesulphonate Mediated Synthesis of Pyrido[2,3-*d*] Pyrimidine Derivative in Aqueous Media.  
**Project Supervisor:** Prof. D.D. Pathak
- **Project Assistant (17/11/2012 – 28/12/2012)**  
 Department of Chemistry  
 Indian Institute of Science Education and Research, Bhopal, India.  
**Project Title:** Polymorphs of Various Organic Compounds.  
**Project Supervisor:** Dr. Deepak Chopra
- **Project Fellow (13/02/2013 – 12/02/2016)**  
 Colloids and Materials Chemistry Department, CSIR-IMMT, Bhubaneswar, India.  
**Funding Source:** CSIR, New Delhi.  
**Project Title:** Bio Specific Aqueous Separation of Metallic Elements (ESC-401).  
**Project Supervisor:** Dr. Sanjib Das
- **Project Assistant III (20/09/2016 – 19/09/2018)**  
 Colloids and Materials Chemistry Department, CSIR-IMMT, Bhubaneswar, India.  
**Funding Source:** SERB, New Delhi.  
**Project Title:** Development of Tunable Zr(IV) based MOFs Towards Selective and Reversible Uptake and Removal of Heavy Metal Ions from Waste Water (GAP-285).  
**Project Supervisor:** Dr. Sanjib Das

#### **Core Proficiency (Experimental):**

- Experience in multi-step synthesis of organic building block followed by polymer synthesis involving different types of organic reaction with highly air and moisture sensitive reaction as well e.g. Grignard reaction, Ullmann reaction, Sonogashira coupling, Suzuki Mayura coupling, Aromatic electrophilic substitution reaction, Hydrogenation reaction etc. under inert atmosphere using standard Schlenk line technique.
- Expertise in performing other usual organic reactions like Bromination, Iodination, Diazo coupling reaction, Click reaction, Knoevenagel condensation etc.
- Isolation of impurities from pure compound, purification by recrystallization, high vacuum distillation, soxhlet extraction and column chromatography during the research work.
- Crystal Growth: I have experience of growing single crystals of MOF materials using various metal salts and synthesized organic ligand via solvothermal reaction condition.
- Synthesis of Reduced grapheme oxide from Graphite powder & its functionalization to make grapheme based porous framework.
- Synthesis of Dipyrromethane complex starting from pyrrole.
- Characterization of the polymers by TGA, DSC, multi nuclear NMR and XPS study.
- I have expertise on High temperature reaction upto 800 °C to develop porous carbon type materials via Carbonization employing ZnCl<sub>2</sub>, KOH etc.
- Knowledge of regular laboratory instruments like Vacuum oven, Isothermal oven, High temperature furnace, Rota evaporator, Optical microscope, Centrifuge, Sonicator etc.
- Drying of different solvents in lab including MeOH, EtOH, THF, 1,4-Dioxane, Ether, DMF, DMSO, DCM, CHCl<sub>3</sub> and bases like Et<sub>3</sub>N, iPrNH<sub>2</sub> etc. using CaH<sub>2</sub>, CaCl<sub>2</sub>, Metallic sodium, KOH, Molecular sieves etc.
- Maintain the documents and Laboratory Notebook crystal clear.

### Core Proficiency (Instrumental):

Instrument	Proficiency
Ultraviolet-Visible Spectrometer (UV-Vis)	Advanced, in hand experience
FTIR-Spectroscopy	Advanced, in hand experience
Surface Area and Gas Adsorption Analyzer (upto 1 bar)	Advanced, in hand experience
High Pressure Gas Adsorption Analyzer (upto 100 bar)	Advanced, in hand experience
Thermogravimetric and Differential Thermal Analysis (TG/DTA)	Advanced, in hand experience
Gas Chromatography-Mass Spectrometry (GC-MS)	FID & TCD, in hand experience
Zeta Potentiometry	Advanced, in hand experience
Contact Angle Measurement	Advanced, in hand experience
Scanning Electron Microscopy (SEM)	Intermediate, in hand experience
Raman Spectroscopy	Intermediate, in hand experience
X-ray Diffraction Analysis (XRD)	Intermediate, in hand experience
Nuclear Magnetic Resonance Spectroscopy (NMR)	Intermediate
High-resolution Mass Spectrometry (HR-MS)	Intermediate

### Teaching Experiences:

Assistant professor, Chemistry Department (01/08/2012 – 31/10/2012)  
Bengal College of Engineering and Technology,  
Durgapur, West Bengal, India.

### List of Publications:

- (1) Newly Designed 1,2,3-Triazole Functionalized Covalent Triazine Frameworks with Exceptionally High Uptake Capacity of both CO<sub>2</sub> and H<sub>2</sub>. **S. Mukherjee**, M. Das, A. Manna, R. Krishna and S. Das, *J. Mater. Chem. A*, **2019**, *7*, 1055-1068. [Impact factor: 9.93]
- (2) Dual Strategic Approach to Prepare Tunable Defluorinated Triazole Functionalized Covalent Triazine Frameworks with Unprecedented Gas Uptake Capacities. **S. Mukherjee**, M. Das, A. Manna, R. Krishna and S. Das, *Chem. Mater.* **2019**, *31*, 3929-3940. [Impact factor: 9.89]
- (3) Metal-Organic Framework Comprising Perfluorobutyl-Tagged Fluorous Micropores with High Affinity for Perfluorinated Compounds and Halogenated Solvents in Vapour Phase. **S. Mukherjee**, M. Das, A. Manna, D. Mandal and S. Das, *Chem. Sci.* (submitted)
- (4) Fluorous Tagged Conjugated Microporous Polymer: An Excellent Separation Platform for Oil-in-Water, Perfluorinated and Volatile Organic Guests Capture. **S. Mukherjee**, A. Manna, M. Das, and S. Das, (Manuscript under preparation for *ACS Appl. Mater. Interfaces*)
- (5) Multitasking Fluorinated Nanoporous Organic Polymer for Size-Exclusive and Charge-Specific Dye Uptake and Selective CO<sub>2</sub> Capture. **S. Mukherjee**, A. Manna, M. Das, and S. Das. (Manuscript under preparation for *J. Mater. Chem. A*)

### Honors:

Qualified CSIR-UGC-NET (National Eligibility Test) 2012, June.  
Qualified IIT(ISM) Dhanbad Entrance Examination (M.Sc Entrance 2009)

### **Conference and Workshop Attended/Presented:**

- (1) UGC sponsored seminar on "Reactivity of atoms and molecules" at Srijoni, Durgapur.
- (2) International conference on frontiers in Energy, Environment, Health and Materials Research-2013 (EEMR-2013), CSIR-IMMT, Bhubaneswar.
- (3) Workshop on Wetting of surfaces-2018 (WoW-2018), CSIR-IMMT, Bhubaneswar.
- (4) Oral Presentation on "Superhydrophobic coating towards oil-water separation", National Conference on Industrial Coating, National Conference on Industrial Coating-2019 (NCIC-2019), CSIR-IMMT, Bhubaneswar.

### **Computational Proficiency:**

*Operating system:* Windows

*General software:* MS-office (Word, Excel, PowerPoint),

*Molecular modeling software:* Chemdraw, ChemsKetch, MarvinSketch, GaussView.

*Instrument software:* ASIQWin, Xcaliber, iSorbHPwin.

*Miscellaneous:* Mestronova (NMR analysis), Fityk (XPS analysis), Origin, XpertHighScore (PXRD analysis), Endnote, Photoshop.

### **Professional Traits:**

Willingness to work in team and hard worker.

Ability to deal with people.

Disciplined & good etiquette.

### **Personal details:**

**Father's Name:** Nirode Kumar Mukherjee

**Date of Birth:** 08-08-1986

**Gender:** Male

**Marital Status:** Married

**Nationality:** Indian

**Language Known:** English, Hindi, Bengali, Odia.

### **DECLARATION**

I hereby declare that the above-mentioned information is correct up to my knowledge and I bear the responsibility for the correctness of the above-mentioned particulars.

*Soumya Mukherjee*

## Doctoral Research Area

My doctoral research area focuses on the design and synthesis of a variety of new generation nanoporous polymeric adsorbent materials with enhanced physicochemical and thermal stability from the view point of prospective applications in gas storage/separation, oil-water separation, removal of hazardous chemical and radioactive waste with long term performance and recyclability to meet realistic industrial requirements. Targeted nanoporous materials were prepared through bottom-up approach using judiciously designed and synthesized organic building blocks comprising specific substituents and assembling them into a predesigned nanoporous material via either metal-ligand coordinate bond formation (MOF) or covalent bond formation (POP). My main objective always lies on the fact that the developed nanoporous materials should have superior physicochemical stability, e.g. water tolerance is known to be the major concern for MOF based materials. Furthermore, synthesized nanoporous materials should have – i) high adsorption capability and selectivity, ii) favourable sorption kinetics, iii) multiple cycles reusability, and iv) economically viable.

***MOF with  
Perfluorobutyl  
Tagged Micropores:  
Gas Adsorption,  
Vapour Uptake of  
Perfluorinated  
Compounds &  
Halogenated  
Solvents***

I have synthesized a newly designed perfluorobutyl chain ( $R_{9f}$ ) decorated microporous Metal-Organic Framework (MOF1- $R_{9f}$ ) material via solvo-thermal synthesis route. The synthesized *fluorous* MOF have been characterized by single crystal XRD and possess extremely high tolerance towards moisture/ water including high thermal stability. Apart from appreciable amount of  $\text{CO}_2$  adsorption at both low pressure and high pressure with high  $\text{CO}_2/\text{N}_2$  selectivity MOF1- $R_{9f}$  showed high affinity towards perfluorinated compounds in vapour phase compared to their non-fluorinated counterpart owing to their excellent fluorophilic character originated from perfluorobutyl decorated pore surfaces. Moreover, we have also carried out the uptake behaviour of various halogenated solvents in vapour phase which revealed their apparent preference towards fluorinated and chlorinated guest molecules.

***Perfluorobutyl  
Chain decorated  
Fluorophilic CMP  
for Separation of  
Oil-in-Water &  
Organic Solvents***

New type of porous perfluorobutyl chain incorporated conjugated microporous polymer (CMP1- $R_{9f}$ ) has been synthesized and structurally characterized by Solid-state  $^{13}\text{C}$  CP/MAS NMR spectrum and FT-IR. The obtained superhydrophobic polymer showed excellent physicochemical stability, appreciable surface area and porosity with fast adsorption kinetics, strong adsorption capability and excellent recyclability for oils, organic solvents, and fluorous guests. Furthermore, CMP1- $R_{9f}$  is coated to a commercially available hydrophilic melamine sponge, which became hydrophobic after coating. The polymer coated sponge absorbs oils and organic solvents with high selectivity and showed good recyclability making a promising candidate for large-scale removal of oils and/or organic solvents from water.

***Multitasking  
Fluorinated POP  
for Size-Exclusive &  
Charge Specific Dye  
Uptake & Selective  
 $\text{CO}_2$  Capture***

A unique multifunctional hydrophobic nanoporous polymer  $F\text{-NOP1}$  was synthesized having fluorine functionalities with narrow pore confinement on the pore walls and highly cross-linked network structure exhibiting efficient adsorption of organic dye molecules in a highly charge-specific and size selective manner. The formation of this low-cost  $F\text{-NOP1}$  polymer was established by FT-IR, solid-state  $^{13}\text{C}$  CP/MAS NMR spectrum and high-resolution XPS analysis.

Furthermore, the resulting polymer showed appreciable CO<sub>2</sub> uptake and separation as well as combining an outstanding heterogeneous catalyst for Knoevenagel condensation reaction obtained via GC-MS analysis. It showed highest reported CO<sub>2</sub>/CH<sub>4</sub> selectivity in addition with very high CO<sub>2</sub>/N<sub>2</sub> selectivity, which is very much uncommon to best reported POP reported till date.

***1,2,3-Triazole  
Functionalized  
CTFs with  
Unprecedented  
CO<sub>2</sub> & H<sub>2</sub> Uptake  
Capacity***

Two novel series of triazole functionalized Covalent Triazine Framework (CTF) based materials have been synthesized through ZnCl<sub>2</sub> mediated ionothermal process using C3-symmetric triazole based trinitrile building blocks comprising of non-fluorinated, partially fluorinated and extensively fluorinated aromatic units namely Tz-HCN, Tz-FCN and Tz-PFCN respectively. Judicious incorporation of multi-N-containing triazole heteroatomic-source of basic N-active sites for enhancing the affinity towards acidic CO<sub>2</sub> molecules and thermally sacrificial different extent of C-F functionality-responsible for enhanced microporous surface area dominated by abundant narrow- and ultra-micropores in the resultant CTF materials synthesized from Tz-FCN and Tz-PFCN building block gave us unprecedented CO<sub>2</sub> and H<sub>2</sub> Uptake Capacity which is highest among all known porous organic polymers including related CTF systems till date.

***Triazole  
Functionalized  
CTFs as High-  
Performing  
Adsorbents for I<sub>2</sub>  
& Dye Capture***

Triazole functionalized CTFs with high specific surface area and large pore volume with hierarchically porous structure have been studied in capturing radioactive I<sub>2</sub> and removing toxic dye from industrial waste water. I<sub>2</sub> adsorption capability was estimated from all the three phases namely vapor, aqueous and organic phase and I<sub>2</sub> loaded CTF material was characterized via XPS, Raman and TGA analysis. These adsorbents with rapid dual uptake properties may be a promising candidate to address waste water treatment and many other environmental issues.

- Involvement in Other Major Projects during Doctoral Study**
- Synthesis of Graphene based materials starting from graphite powder to grapheme oxide followed by reduced graphene oxide and so on.
  - Synthesis of Dipyrromethane complex starting from pyrrole.
  - Synthesis of various Schiff base polymers.

**In my Ph.D work I have contributed some excellent results such as**

- i) First time I have developed two uniquely designed nanoporous solid state fluorous phase (one MOF and one CMP) that selectively uptake fluorinated guests.
- ii) I have achieved two series of novel CTFs, a new benchmark material for CO<sub>2</sub> capture and H<sub>2</sub> storage.
- iii) A low cost multitasking polymer for exclusively charge dependent and size selective dye uptake and efficient catalyst for Knoevenagel condensation.
- iv) A nitrogen & oxygen doped material for efficient and rapid removal of radioactive iodine from aqueous, organic and vapour phase.