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Chemically Robust
Metal-Organic Frameworks
(MOFs) and Hydrogen-Bonded
Organic Frameworks (HOFs)
toward Plausible Applications in
Gas Separation and Proton
Conduction



Abstract

Chemically Robust Metal-Organic Frameworks (MOFs) and Hydrogen-Bonded Organic Frameworks (HOFs) toward Plausible Applications in Gas Separation and Proton Conduction

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The presentation includes the discussion on design strategy, synthesis and energy-related applications of tailored porous metal organic frameworks (MOFs) and hydrogen-bonded organic frameworks (HOFs) performed in the 'Framework Laboratory' at IIT-Kharagpur. The microporous frameworks developed by us (known as MOF: IITKGP) are chemically robust (water, or wide range of pH) which is a topic of significant importance while considering them for practical energy-related applications. The MOFs show great potential toward various energy-saving adsorption-based industrially important gas separations such as flue gas (CO₂/N₂), biogas (CO₂/CH₄), C₂H₂/C₂H₄, C₂H₂/CO₂, C₂s/CH₄. Besides gas separations, performances of specially designed MOFs and HOFs as ultrahigh superprotonic solid state conductors for plausible usage as proton-exchange membrane (PEMs) will also be presented.

1. "Highly Scalable Acid-Base Resistant Cu-Prussian Blue Metal-Organic Framework for C₂H₂/C₂H₄, Bio Gas, and Flue Gas Separations" S. C. Pal, R. Krishna, and M. C. Das; *Chemical Engineering Journal* 2023, 460, 141795.
2. "pH-stable MOFs: Design Principles and Applications" B. Pramanik, R. Sahoo, and M. C. Das; *Coord. Chem. Rev.* 2023, 493, 215301.
3. "A Microporous Water Stable MOF for Consistent and Selective C₂H₂/C₂H₄ Separation" A. Pal, S. C. Pal, H. Cui, R.-B. Lin, D. Singha, M. K. Rana, B. Chen and M. C. Das; *Separation and Purification Technology* 2023, 320, 124208.
4. "Solid-State Proton Conduction Driven by Coordinated Water Molecules in Metal-Organic Frameworks and Coordination Polymers" R. Sahoo, S. C. Pal, and M. C. Das; *ACS Energy Letters* 2022, 7, 4490.
5. "Emerging Microporous HOF Materials to Address Global Energy Challenges" M. C. Das, S. C. Pal, and B. Chen; *Joule* 2022, 6, 22.
6. "MOFs for CO₂ Separation from Flue and Biogas Mixtures" R. Sahoo, S. Mondal, D. Mukherjee, and M. C. Das; *Adv. Functional Mater.* 2022, 2207197.
7. "Potential of A pH Stable Microporous MOF for C₂H₂/C₂H₄ and C₂H₂/CO₂ Gas Separations under Ambient Conditions" S. C. Pal, R. Ahmed, A. K. Manna, and M. C. Das; *Inorg. Chem.* 2022, 61, 18293.
8. "Proton Conducting Hydrogen-Bonded Organic Frameworks (HOFs)" S. C. Pal, D. Mukherjee, R. Sahoo, S. Mondal, and M. C. Das; *ACS Energy Letters* 2021, 6, 4431.
9. "Superprotonic Conductivity of MOFs and Other Crystalline Platforms beyond 10⁻¹ S cm⁻¹" S. C. Pal and M. C. Das; *Adv. Functional Mater.* 2021, 31, 2101584.
10. "Immobilization of a Polar Sulfone Moiety onto the Pore Surface of a Humid Stable MOF for Highly Efficient CO₂ Separation under Dry and Wet Environment through Direct CO₂-Sulfone Interactions" A. Pal, S. Chand, D. G. Madden, D. M. Franz, L. Ritter, B. Space, T. Curtin, S. C. Pal and M. C. Das; *ACS Applied Materials & Interface.* 2020, 12, 41177.
11. "A 2D Mg(II)-MOF with High Density of Coordinated Waters as Sole Intrinsic Proton Sources for Ultrahigh Superprotonic Conduction" S. Chand, S. C. Pal, D.-W. Lim, K. Otsubo, A. Pal, H. Kitagawa, and M. C. Das; *ACS Materials Letters.* 2020, 2, 1343.
12. "Polycarboxylates Templated Coordination Polymers: Role of Templates for Superprotonic Conductivities up to 10⁻¹ S cm⁻¹" S. M. Elahi, S. Chand, W.-H. Deng, A. Pal and M. C. Das; *Angew. Chem., Int. Ed.* 2018, 57, 6662.

Biography

Bio of Dr. Madhab C. Das

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Madhab C. Das completed his Ph.D. in Supramolecular Chemistry at Indian Institute of Technology (IIT) Kanpur under the supervision of Professor P.K. Bharadwaj (Nov, 2009). Then, he worked with Professors Banglin Chen at the University of Texas at San Antonio, George K.H. Shimizu at University of Calgary, and Hiroshi Kitagawa at Kyoto University as postdoctoral fellow (Dec, 2009–Nov, 2013). At Kyoto university he worked as a JSPS postdoctoral researcher. He joined at IIT Kharagpur as an Assistant Professor in Dec, 2013. Since 2019, he is an Associate Professor at IIT Kharagpur. He received AvH fellowship as Experienced Researcher in 2022. His work is focused on functional MOFs and HOFs mostly toward gas separations, proton conduction, sensing, electrochemical energy storage, and catalysis.