

## Chemically Robust Metal-Organic Frameworks (MOFs) and Hydrogen-Bonded Organic Frameworks (HOFs) toward Plausible Energy Applications

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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 frameworks are microporous with considerable solvent accessible volume and form channels with the dimensions ranging from  $\sim 3\text{-}7$  Å. As the stability in presence of moisture, water, or wide range of pH is a topic of significant importance while considering them for practical energy-related applications, these frameworks do reveal high stability toward moisture, water and acid-base solutions. The MOFs show great potential toward various energy-saving adsorption-based industrially important gas separations such as flue gas ( $\text{CO}_2/\text{N}_2$ ), biogas ( $\text{CO}_2/\text{CH}_4$ ),  $\text{C}_2\text{H}_2/\text{C}_2\text{H}_4$ ,  $\text{C}_2\text{H}_2/\text{CO}_2$ ,  $\text{C}_2/\text{CH}_4$ . Besides gas separations, performances of MOFs and HOFs as superprotonic solid state conductors for plausible usage in fuel cells as proton-exchange membrane (PEMs) will also be presented.

1. "Highly Scalable Acid-Base Resistant Cu-Prussian Blue Metal-Organic Framework for  $\text{C}_2\text{H}_2/\text{C}_2\text{H}_4$ , Bio Gas, and Flue Gas Separations" S. C. Pal, R. Krishna, and M. C. Das; *Chemical Engineering Journal* **2023**, *460*, 141795.
2. "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*, 4490-4500.
3. "Emerging Microporous HOF Materials to Address Global Energy Challenges" M. C. Das, S. C. Pal, and B. Chen; *Joule* **2022**, *6*, 22-27.
4. "MOFs for  $\text{CO}_2$  Separation from Flue and Biogas Mixtures" R. Sahoo, S. Mondal, D. Mukherjee, and M. C. Das; *Adv. Functional Mater.* **2022**, 2207197.
5. "Potential of A pH Stable Microporous MOF for  $\text{C}_2\text{H}_2/\text{C}_2\text{H}_4$  and  $\text{C}_2\text{H}_2/\text{CO}_2$  Gas Separations under Ambient Conditions" S. C. Pal, R. Ahmed, A. K. Manna, and M. C. Das; *Inorg. Chem.* **2022**, *61*, 18293.
6. "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*, 4431-4453.
7. "Superprotonic Conductivity of MOFs and Other Crystalline Platforms beyond  $10^{-1}$  S  $\text{cm}^{-1}$ " S. C. Pal and M. C. Das; *Adv. Functional Mater.* **2021**, *31*, 2101584.
8.  $\text{C}_2\text{s}/\text{C}_1$  Hydrocarbon Separation: The Major Step towards Natural Gas Purification by Metal-Organic Frameworks (MOFs)" R. Sahoo and M. C. Das; *Coord. Chem. Rev.* **2021**, *442*, 213998.
9. "Immobilization of a Polar Sulfone Moiety onto the Pore Surface of a Humid Stable MOF for Highly Efficient  $\text{CO}_2$  Separation under Dry and Wet Environment through Direct  $\text{CO}_2$ -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*, 41177-41184.
10. "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*, 1343-1350.
11. "Polycarboxylates Templated Coordination Polymers: Role of Templates for Superprotonic Conductivities up to  $10^{-1}$  S  $\text{cm}^{-1}$ " S. M. Elahi, S. Chand, W.-H. Deng, A. Pal and M. C. Das; *Angew. Chem., Int. Ed.* **2018**, *57*, 6662-6666.