Institute of SCIENCE TOKYO

講 演 会

“Chemically Robust MOFs and HOFs toward Gas Separation and Proton Conduction”

講演：Prof. Madhab C. Das

（Department of Chemistry, Indian Institute of Technology Kharagpur）

日時：2026年12月4日(金) 10:30 – 11:30

場所：北3号館（EEI棟）2階西側会議室（211）

連絡教員：化学系　河野 正規

（mkawano@chem.sci.isct.ac.jp）

Bio of Madhab C. Das

Professor, Department of Chemistry, Indian Institute of Technology Kharagpur, WB, 721302.
Email: mcdas@chem.iitkgp.ac.in, Web: https://www.chemiitkgp-mcdaslab.com/

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 Professor Banglin Chen at the University of Texas at San Antonio (USA), Professor George K.H. Shimizu at University of Calgary (Canada), and Professor Hiroshi Kitagawa at Kyoto University (Japan) as postdoctoral fellow (during 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 and promoted to Associate professor in 2019. Since 2026, he is a Professor at IIT Kharagpur. He received "AvH fellowship as Experienced Researcher" in 2022 and visited University of Augsburg (Germany) during summers of 2023-2025. In 2026, he received 'The Distinguished Lectureship Award' by the Chemical Society of Japan (CSJ).

His work is focused on functional metal-organic frameworks (MOFs) and hydrogen-bonded organic frameworks (HOFs) toward gas separations, proton conductions, sensing, electrochemical energy storage and heterogeneous catalysis.

Abstract

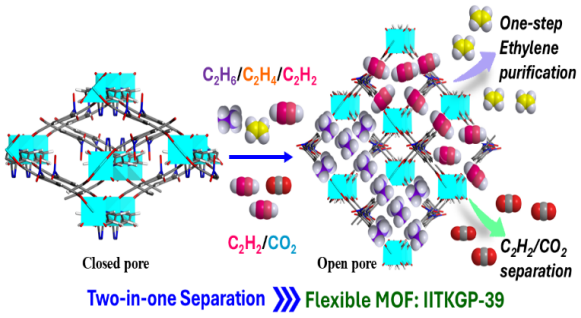
Chemically Robust MOFs and HOFs toward Gas Separation and Proton Conduction

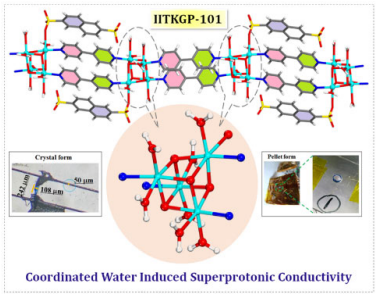
Madhab C. Das
Professor, Department of Chemistry, Indian Institute of Technology Kharagpur, WB, 721302.

Email: mcdas@chem.iitkgp.ac.in
Homepage: https://www.chemiitkgp-mcdaslab.com/

This presentation addresses the design strategies, synthetic methodologies, and energy-related applications of tailored porous metal–organic frameworks (MOFs) developed in the *Framework Laboratory* @ IIT Kharagpur. The microporous frameworks produced by our group (collectively referred to as MOF-IITKGP) exhibit exceptional chemical robustness, including stability in water and across a wide pH range - a feature of considerable importance for their practical deployment. These MOFs demonstrate strong potential for energy-efficient, adsorption-based separations of industrially relevant gas mixtures, including flue gas (CO_2/N_2), biogas (CO_2/CH_4), C_2H_2/C_2H_4, C_2H_2/CO_2, and C_2s/CH_4.[1-4] Both binary and multicomponent gas mixtures separations will be presented.

Furthermore, these materials have shown high promise as solid-state proton conductors (SSPCs).[5-7] While numerous studies have employed extrinsic or guest-derived species to enhance proton conduction in MOFs, the role of metal-coordinated protic solvents - such as water as intrinsic proton donors has received comparatively less attention. Our recent work illustrates how coordinated water molecules can be strategically leveraged to achieve efficient proton conduction within MOFs. Besides, a few examples of HOFs as SSPCs will also be presented.[8-9]





1. R. Sahoo, B. Pramanik, R. Krishna, and M. C. Das, *Small* **2026**, *22*, e72629.
2. D. Mukherjee, S.C. Pal, J.-X Wang, V. Bon, S. Chand, S. Kaskel, B. Li, D. Volkmer, M. C. Das, *J. Am. Chem. Soc.* **2025**, *147,* 29255.
3. S. C. Pal, J. Behera, T. -F. Zhang, R. Ahmed, A. Pal, J. -X Wang, A. K. Manna, B. Li, M. C. Das, *Chemical Engineering Journal* **2025**, *511*, 162121.
4. B. Pramanik, R. Sahoo, R. Krishna, M. C. Das, *Small* **2025**, *21,* 2411456.
5. S. C. Pal, D. Mukherjee, Y. Oruganti, B. G. Lee, D.-W. Lim, B. Pramanik, A. K. Manna, M. C. Das, *J. Am. Chem. Soc.* **2024**, *146,* 14546-14557.
6. S. Chand, S. C. Pal, D.-W. Lim, K. Otsubo, A. Pal, H. Kitagawa, M. C. Das, *ACS Materials Letters*. **2020**, *2*, 1343.
7. S. M. Elahi, S. Chand, W.-H. Deng, A. Pal, M. C. Das, *Angew. Chem., Int. Ed.* **2018**, *57*, 6662.
8. D. Mukherjee, S. C. Pal, S. Zhang, A. M. Tedy, A. Saha, A. K. Manna and M. C. Das, *Angew. Chem. Int. Ed.* **2025**, *64*, e202510470.
9. S. Chand, W. -H. Deng, S. C. Pal, A. Saha, A. K. Manna, and M. C. Das, *ACS Energy Letters* **2026**, *11*, 451–463.