Ramanathan Vaidhyanathan
Associate Professor
Department of Chemistry
IISER Pune

Exploring COFs for Lightweight and Fast Charging Storage

Abstract: Of the many inorganic and organic framework materials, Covalent Organic Framework (COF) as crystalline organic polymer has enjoyed a rapid surge since 2005. COF's modular framework with a wide range of synthetically accessible functional monomers qualifies them for tailor-made applications. Typically constructed from C, H, N, O, they roll out as lightweight, high surface area powders. Their relatively large micro-mesopores favor rapid diffusion of guests and expand the range of guests they can store. These make them an impending candidate in rapid charge-discharge systems- A demand of the day. Their additional advantages, such as exceptional chemical, mechanical and thermal robustness, processability, and recyclability, open up many possibilities. Still, there are open questions about how easy it is to process these insoluble fluffy powders as components in working devices? What is their durability under demanding electrochemical environments? The presentation would have upshots from due investigative studies.

1. Covalent Organic Frameworks for Batteries, Dongyang Zhu, Guiyin Xu, Morgan Barnes, Yilin Li, Chia-Ping Tseng, Zhuqing Zhang, Jun-Jie Zhang, Yifan Zhu, Safiya Khalil, Muhammad M. Rahman, Rafael Verduzco, Pulickel M. Ajayan, Volume 31, 2021, 2100505 (2021).
2. Exceptional Capacitance Enhancement of a Non-Conducting COF through Potential-Driven Chemical Modulation by Redox Electrolyte, Rinku Kushwaha, Sattwick Haldar, Pragalbh Shekhar, Akshara Krishnan, Jayeeta Saha, Pramiti Hui, Chathakudath Prabhakaran Vinod, Chandramouli Subramaniam, and Ramanathan Vaidhyanathan, Adv. Energy Mater., 1, 2003626 (2021).
3. Chemical Exfoliation as a Controlled Route to Enhance the Anodic Performance of COF in LIB, Sattwick Haldar, Kingshuk Roy, Rinku Kushwaha, Satishchandra B. Ogale, and Ramanathan Vaidhyanathan, Adv. Energy. Mater., 9,1902428 (2019).
4. Pyridine-Rich Covalent Organic Frameworks as High-Performance Solid-State Supercapacitors, Sattwick Haldar, Rinku Kushwaha, Rahul Maity and Ramanathan Vaidhyanathan,(2019) ACS Mater. Lett., 1, 490-497 (2019).

R. Vaidhyanathan obtained his Ph.D. from the Jawaharlal Nehru Centre for Advanced Scientific Research under Prof. C. N. R. Rao and Prof. S. Natarajan. He worked as a postdoc with Prof. M. J. Rosseinsky at the University of Liverpool and as a research associate with Prof. George Shimizu at the University of Calgary. He started his independent research career as an assistant professor in IISER Pune in 2012. Currently, he is an Associate Professor at IISER Pune. His research focuses on developing Advanced Porous Materials such as metal-organic frameworks (MOFs) and covalent-organic frameworks (COFs) and their nanocomposites for environmental and energy applications. He has published over 95 papers and has 11 patents filed from IISER Pune. He has been rewarded with several honors, including the C.N.R. Rao Award. National Prize for research in Physical and Inorganic Chemistry (2021), Materials Research Society of India Medal (2019), Chemical Research Society of India Medal (2018), IUSSTF funding won jointly with Temple University (Chief Co-PI, 2018), Sakurai Science Program (SSP), Osaka University, Japan (2016), Best Emerging Young Scientist (Chemical Frontiers), Goa, (2017). He serves as an Editorial Board Member of ***ACS Materials Letters*** and ***Nature Scientific Reports***.