

Covalent Organic Frameworks

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Covalent organic frameworks (COFs) are a class of crystalline, porous polymers formed from the reversible covalent reactions between organic building blocks, resulting in ordered structure, permanent porosity, and topologically diversified. Since Yaghi and co-workers successfully synthesized the first COF in 2005, COFs have experienced rapid development and have been widely studied in various fields such as adsorption/separation, heterogeneous catalysis, and energy storage due to their fascinating structural characteristics and ease of modifying pore environment. However, as a relatively new class of materials, COFs had faced a series of challenges: time-consuming syntheses, which would be incompatible at large-scales; the synthesis of single crystal COFs is arduous, and the structure of polycrystalline COFs cannot be accurately analyzed; the COF film formation process still requires tremendous understanding and improvement.

To better promote the development of COFs and their practical applications, we are honored to organize this special issue entitled “Covalent Organic Frameworks” in “Macromolecular Rapid Communications”. The issue features 15 original research articles and 3 review articles, covering recent advances in the exploration of synthetic methods, expansion of structural design, and application of COFs in organic optoelectronics, heterogeneous catalysis, and membrane separation.

The development of new synthetic strategies is of great significance for the construction and practical application of COFs. In this special issue, M. El-Kaderi and co-workers reported the synthesis of a redox-active pyrene-containing polyimide COF (PICOF-1) by linker exchange using an imine-linked COFs as a template (article 2200782). Thomas et al. further expanded the method of linker exchange to the synthesis of β -ketoenamine linked COFs and achieved a very good control on the ratio of the respective building blocks within the framework (article 2300046). Li et al. successfully prepared a family of porous polyureas and polyamides via domino polymerization with the aid of a bifunctional monomer (article 2200712). In order to improve the production efficiency of COFs, He and co-workers reported a “thermally promoted homogenous-floating-concentrating” strategy for the rapid synthesis of highly crys-

talline triazine/hydroxyl-rich COFs under mild conditions (article 2200786). Zhang et al. developed an effective solvent-free synthetic method to construct a series of two-dimensional imine-linked, azine-linked, and β -ketoenamine-linked COFs, which overcame the limitations of solvothermal synthesis and achieve gram scale production (article 2200722).

To expand the topological diversity of COFs, the design and synthesis of novel building blocks have been proven important. Chen and co-workers ingeniously designed and synthesized a new K-shaped “two-in-one” building unit, thus realizing the construction of triangular dual-microporous COF (BPTD-COF) via self-polycondensation of the K-shaped monomer (article 2200894). Huang et al. developed a new perylene-based 2D COFs using the $C_2 + C_2$ topological diagram, which has high porosity and tetragonal micropores. After doping with fullerene, the electrical conductivity of TFPer-TAPPer COF is greatly increased (article 2200715).

The functional applications of COFs have been a topic of intense research interest. Tian and co-workers successfully prepared a copper-coordinated COF which can produce a robust Fenton-like effect inducing immunogenic cell death of tumors (article 2200929). Das and co-workers synthesized a highly emissive sub-stoichiometric 2D-COF (COF-SMU-1) featuring free uncondensed aldehyde groups, which exhibits tunable emission in various organic solvents, and distinct colorimetric changes in the presence of water (article 2200751). Ma et al. explored the hydrolytic capabilities of an ultra-stable quinoline-linked sulfonic acid functionalized COFs on the glycosidic bond of cellobiose and other common disaccharides in neutral, metal-free, and aqueous conditions (article 2200724). Liu et al. constructed a new framework material (COF-JLU82) with bifuorenylidene and benzoselelenadiazole units and investigated its ORR electrocatalytic activity (article 2200717). Gu et al. had taken a bottom-up strategy to anchor phosphoric acid groups into the COF structure and synthesized a phosphoric acid-functionalized COF which exhibits good intrinsic proton conductivity (article 2200678).

Developing high-performance COF membranes is important for separation applications. Fang and co-workers obtained COF membranes with excellent nanofiltration performance under simple and mild conditions (article 2200774). Ma and co-workers integrated two kinds of ionic 2D COFs with different charge properties into polyacrylonitrile (PAN) substrates to form a two-component composite membrane (PAN@iCOFs), featuring with excellent perfluoroalkyl substances (PFASs) separation performance (article 2200718). Zhao et al. prepared a superhydrophobic membrane composited with a trifluoromethyl-containing COF, which exhibits excellent performance on separations of oil/water mixtures and water-in-oil emulsions (article 2200641).

Lastly, the issue features three invited review articles, providing an overview of recent advances in COFs. Wang and co-workers presented recent advances of COFs in the application as commercial separator modifiers and proposed some new strate-

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gies for the design of COF-based separator modifiers to achieving high energy density (article 2200760). Guo and co-workers delineated the rapid progress of two-dimensional (2D) COFs on visible photocatalytic H₂ production from water and concluded with the current challenges and promising opportunities for developing COF-based photocatalysts (article 2200719). Han and co-workers summarized the synthesis and application of fluorinated COFs and provided insights into the development prospects (article 2200778).

In conclusion, we express our gratitude to the contributors of this special issue and the editorial team of Macromolecular Rapid

Communications. We hope that this issue will provide the audiences with novel insights, accelerate the development of COFs, and provide some solutions to the challenges faced by this emerging material.

Conflict of Interest

The authors declare no conflict of interest.

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Qianrong Fang received his B.S. (2001) and Ph.D. (2007) from Jilin University, China. From 2007 to 2014, he completed his postdoctoral study at the University of California at Los Angeles, Texas A&M University, University of California at Riverside as well as University of Delaware. In 2015, he went back to Jilin University, as a full professor. His current research focuses on the design and synthesis of covalent organic frameworks (COFs) for application in adsorption, separation, catalysis, and other fields.



Shengqian Ma obtained his B.S. degree from Jilin University, China in 2003, and graduated from Miami University (Ohio) with a Ph.D. degree in 2008. After finishing two-year Director's Postdoctoral Fellowship at Argonne National Laboratory, he joined the Department of Chemistry at University of South Florida (USF) as an Assistant Professor in August 2010; he was promoted to an Associate Professor with early tenure in 2015 and to a Full Professor in 2018. In August 2020, he joined the Department of Chemistry at University of North Texas (UNT) as the Welch Chair in Chemistry. His current research interest focuses on the development of functional porous materials including metal-organic frameworks (MOFs), covalent organic frameworks (COFs), and porous organic polymers (POPs) for energy, biological, environmental-related applications.