

## **Recent Advancement in Metal-Organic Framework: Synthesis, Activation, Functionalization, and Bulk Production**

### **Abstract**

Metal-organic framework (MOF) is an emerging hybrid material that possesses high surface area, narrow pore size distribution, and tuneable functionality. In recent years, MOF-based materials have been widely studied in various applications such as gas storage, gas separation, heterogeneous catalysis, and drug delivery. However, less emphasis has been placed on the fundamentals of MOF that are crucial to provide scientific knowledge for tailoring MOFs with desirable properties for commercial applications. This review discusses recent advancement in the MOF chemistry, in particular, synthesis, activation, functionalisation, and bulk production of MOFs. This review will be of great interest to the researchers and chemists actively involved in the field of MOFs production. Abbreviations: BBR: Building block replacement; BDC: 1,4-benzenedicarboxylate; BET: Brunauer-Emmett-Teller; BTC: 1,3,5-benzenetricarboxylate; Boc: Tert-butoxycarbonyl; Bpy: 4,4'-bipyridine; CFG: Carboxylic functional group; CTAB: Cetyltrimethylammoniumbromide; DABCO: 1,4-diazabicyclo[2.2.2]octane; DEF: N,N-diethylformamide; DMF: N,N-dimethylformamide; Dhybdc: 2,5-dihydroxy-1,4-benzenedicarboxylate; [EMIm]Br: 1-ethyl-3-methylimidazolium bromide; FIR: Fujian Institute of Research; H2BDC: 1,4-benzenedicarboxylic acid; H3BTC: 1,3,5-benzenetricarboxylic acid; H4TBAPy: 1,3,6,8-tetrakis(p-benzoic acid)pyrene; HKUST: Hong-Kong University of Science and Technology; ICP-MS: Inductively coupled plasma mass spectrometry; ILAG: Ion- and liquid-assisted grinding; Im: Imidazole ; IPA: Isophthalate; IRMOF: Isorecticular metal-organic framework; IUPAC: International Union of Pure and Applied Chemistry; LAG: Liquid-assisted grinding; LBL: Layer-by-layer; LIB: Lithium-ion battery; mesoMOF: Mesoporous metal-organic framework; MeIm: 2-methylimidazole; MIL: Matériaux de l'Institut Lavoisier; MixMOF: Mixed-linker metal-organic framework; MOF: Metal-organic framework; MTBS: Methyltributylammoniummethylsulfate; NH2BTC: 2-aminobenzene-1,3,5-tricarboxylate; NOTT: University of Nottingham; NU: Northwestern University ;

PCD: Protection-complexation-deprotection; PCN: Porous coordination network; PCP: Porous coordination polymer; PIM: Polymer of intrinsic microporosity; PSD: Post-synthetic deprotection; PSM: Post-synthetic modification; PXRD: Powder X-ray diffraction; PyCHO: 2-pyridinecarboxaldehyde; RH: Relative humidity; SALE: Solvent-assisted linker exchange; SALI: Solvent-assisted ligand incorporation; scCO<sub>2</sub>: Supercritical carbon dioxide; STEM: Scanning transmission electron microscopy; STY: Space–time yield; TBHP: tert-butyl hydroperoxide; TMU: Tarbiat Modares University; UiO: Universitetet i Oslo; ZIF: Zeolitic imidazolate framework