Metal-Organic Frameworks for Advanced Polymers

Takashi Uemura
The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan
uemurat@g.ecc.u-tokyo.ac.jp

Metal-Organic Frameworks (MOFs) composed of metal ions and organic ligands have been extensively studied. The characteristic features of MOFs are highly regular channel structures with controllable pore sizes approximating molecular dimensions and designable surface functionality. Thus, MOFs have been successfully applied in numerous domains, including storage and separation, catalysis, energy, and sensing. However, the majority of relative studies in the early stages of MOF research focused on gas and solvent molecules as guests, despite the potential of infinite nanochannel structures for the encapsulation of macromolecules.

Since 2005, we have utilized the regular and tunable channels of MOFs for a field of polymerization, which can allow multi-level controls of polymers, nanoparticles, and nanographenes (Figure 1).[1] In addition, construction of nanocomposites between MOFs and polymers provides unprecedented material platforms to accomplish many nanoscale function.[2] We have also developed direct insertion of polymers into nanochannels of MOFs, which enables powerful macromolecular recognition and separation technologies with exceptionally high selectivity.[3] Designing nano-sized pores of MOFs with a regular arrangement of reactive/interactive/responsive entities offers the possibility of universal polymer production and purification that cannot be accomplished by conventional methods.

References

[1] (a) *Nat. Commun.* **2018**, *9*, 329. (b) *Chem. Commun.* **2018**, *54*, 11843. (c) *J. Am. Chem. Soc.* **2019**, *141*, 19565. (d) *Nat. Commun.* **2020**, *11*, 3573. (e) *J. Am. Chem. Soc.* **2020**, *142*, 5509. (f) *J. Am. Chem. Soc.* **2023**, *145*, 2448. (g) *Nat. Synth.* **2023**, *2*, 848.

[2] (a) *Chem. Soc. Rev.* **2017**, *46*, 3108. (b) *J. Am. Chem. Soc.* **2017**, *139*, 7886. (c) *Nat. Commun.* **2018**, *9*, 1660. (d) *J. Am. Chem. Soc.* **2019**, *141*, 14549. (e) *Angew. Chem. Int Ed.* **2021**, *60*, 17947. (f) *Nat. Commun.* **2023**, *14*, 3241.

[3] (a) *Nat. Commun.* **2018**, *9*, 3635. (b) *J. Am. Chem. Soc.* **2020**, *142*, 3701. (c) *Matter* **2020**, *3*, 652. (d) *Angew. Chem. Int. Ed.* **2021**, *60*, 11830. (e) *ACS Nano* **2022**, *16*, 6771. (f) *Chem* **2023**, *9*, 2817.

Figures

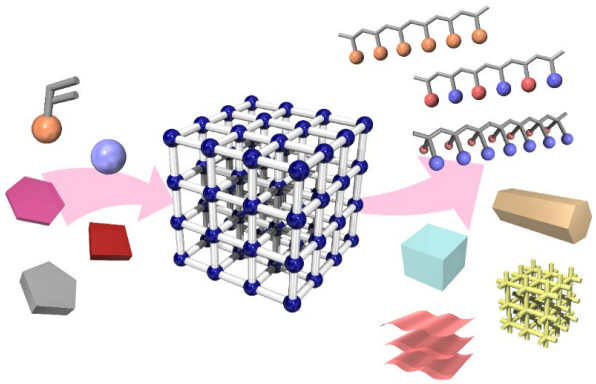

Figure 1: Controlled polymerizations using MOFs