Polymer Chemistry in Metal-Organic Frameworks

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Recently, 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, controllable channel sizes approximating molecular dimensions, and designable surface functionality. Use of their regulated and tunable channels for a field of polymerization allows multi-level controls of resulting polymer structures.[1] In addition, construction of nanocomposites between MOFs and polymers provides unprecedented material platforms to accomplish many nanoscale functions.[2]

Controlled radical polymerization of vinyl monomers was attained in MOF nanochannels, showing many remarkable effects of pore size, shape, and functionality on the structures of resulting polymers.[3] For example, stereo- and regioregularity of polymers could be systematically controlled depending on the pore structure.[3a-c] Controlled uniaxial alignment of vinyl polymer chains was achieved by host-guest cross-polymerization.[3d] Use of MOFs as removable templates was a promising method for the mixing of immiscible polymer pairs at the molecular level.[3e] We have also developed radical polymerization using porous organic cages with dynamic and responsive packing structure, showing enzyme-mimetic behaviors that cannot be attained in conventional rigid hosts.[4]

Other than vinyl polymers, a variety of functional polymers, such as biopolymers[5], inorganic polymers[6], and conducting polymers[7], could be prepared/incorporated in MOFs, providing distinctly different properties to those prepared in the bulk state because of the formation of specific polymer assemblies and conformations.

References

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