Metal–organic frameworks for hydrogen storage

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Abstract

Metal–organic frameworks (MOFs) are a class of inorganic–organic hybrid porous crystalline materials consisting of metal ions or metal clusters linked with organic ligands via coordination bonds to form one-, two-, or three-dimensional networks. The flexibility of changing the metal centers and organic ligands allows a wide range of MOFs to be designed, and by careful selection of the constituents, MOFs with desired structures and tailored properties can be produced. MOFs possess several properties that make them particularly attractive for hydrogen storage such as their extraordinarily high surface areas, ultrahigh porosities, tunable pore sizes, and modifiable internal surfaces. Since the first investigation of hydrogen storage in MOFs was reported by Yaghi and co-workers (Rosi et al., 2003), MOFs have been extensively studied for hydrogen storage over the past decade. This chapter provides an overview of MOFs for hydrogen storage. It begins with Section 7.2 discussing synthetic considerations including some of the main methods that have been used to synthesize MOFs. In Section 7.3, hydrogen storage in MOFs at cryogenic temperatures is examined. This section includes studies done at low pressure as well as those conducted at high pressure for various types of MOFs. The factors influencing hydrogen uptake are also presented. Section 7.4 focuses on hydrogen storage at room temperature. Here, some of the efforts to enhance the interactions between hydrogen and MOFs are highlighted. The use of MOFs for nanoconfinement of various chemical hydrides for chemical hydrogen storage is presented in Section 7.5. To conclude, Section 7.6 provides a summary, draws conclusions, and lays out the prospects for MOFs in hydrogen storage.