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Review

Multi-functional sites catalysts based on post-synthetic modification of metal-organic frameworks

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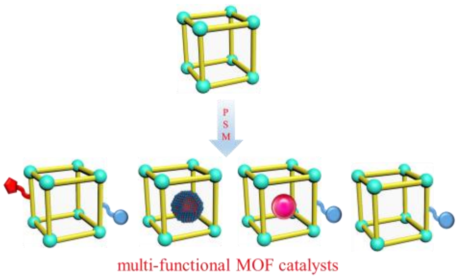
Graphical Abstract



Multi-functional sites MOFs have been explored as a new type of heterogeneous catalytic materials, which can be constructed by various post-synthetic modifications.

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ABSTRACT

Metal-organic frameworks (MOFs) are a unique class of porous crystalline materials that have shown promise for a wide range of applications. MOFs have been explored as a new type of heterogeneous catalytic materials, because of their high surface area, uniform and tunable pores, facile functionalization and incorporation of catalytic active sites. The use of multi-functional sites MOF materials as catalysts for synergistic catalysis and tandem reactions has attracted increasing attention. In this review, we aim to introduce the construction of bi- or multi-functional MOF catalysts with cooperative or cascade functions *via* post-synthetic modification (PSM).

1. Introduction

Metal-organic framework (MOF) materials have rapidly developed as a new type of porous materials with promising applications in the fields of gas storage and separation [1,2], molecular sensing [3,4], proton conduction [5], drug delivery [6], and catalysis [7-10]. Compared with conventional zeolites, MOF catalysts often show several advantageous features such as high surface area, uniform and tunable pores, facile functionalization and incorporation of catalytic active sites. Generally, two strategies have been used for constructing functional MOF catalysts including the pre-assembly of functional building blocks and post-synthetic modification (PSM) of MOFs with active functional sites [11]. The latter strategy is much easier and more flexible compared with the former in obtaining porous MOF catalysts with specific and controllable topologies. Functional MOF catalysts currently achieved by PSM methods consist of three established techniques (Scheme 1): (1) PSM of open metal sites *via* coordination bond interactions [12]; (2) PSM of organic ligands through organic synthesis [13,14]; (3) encapsulation of functional guest molecules in the pores or cages of MOF materials [15,16]. To date, several reviews have been published about the application of MOF as catalysts [7-10]. In this review, we aim to focus