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REVIEW

A Review on Metal-Organic Frameworks: Synthesis and Applications

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Metal-organic frameworks (MOFs) are inorganic-organic hybrid porous materials that are composed of positively charged metal ions and organic linkers. The metal ions form nodes that connect the arms of the linkers together to form one-, two-, or three-dimensional structures. Due to this void structure, MOFs have an unusually large internal surface area. They have received enormous interest in recent years particularly as newly developed porous materials. They possess a wide range of potential applications like gas storage, catalysis, sensors, drug delivery, adsorption, *etc*. In present review article, synthetic methods and applications of MOFs have been discussed.

Keywords: Metal-organic frameworks, Synthesis techniques, Gas storage, Sensors, Catalysts, Drug delivery.

INTRODUCTION

Metal-organic frameworks (MOFs) were first discovered in the year of 1965. MOFs are a class of compound in which metal centers or clusters and multidentate organic groups as linkers [1-4] are coupled together by coordinate bonds to form one-, two- and three-dimensional highly porous structures [5] as shown in Fig. 1. So, metal-organic frameworks (MOFs) are inorganic-organic hybrid porous materials. In general, MOFs are called as coordination polymers. However, for 2D and 3D networks the term MOF is more appropriate than coordination polymer. Thus these are also called as porous coordination polymers (PCPs) [6,7]. Several coordination geometries such as octahedral, tetrahedral, trigonal-planar, *etc*. and also interesting structural architectures are obtained by varying the coordination number of metal ions. Transition metals, lanthanides, actinides, *p*-block elements, alkaline earth metals and even mixed metals are usually employed for the formation of MOFs. The N-containing aromatics or multivalent aromatic carboxylic acids are commonly used as organic linkers in MOFs.

Over the last two decades, a lot of research work has been done on MOFs. Due to structural flexibility, high surface area, small density and tunable pore size, MOFs have a wide range of potential applications in the field of gas adsorption and storage, separation, catalysis, sensing, molecular recognition,

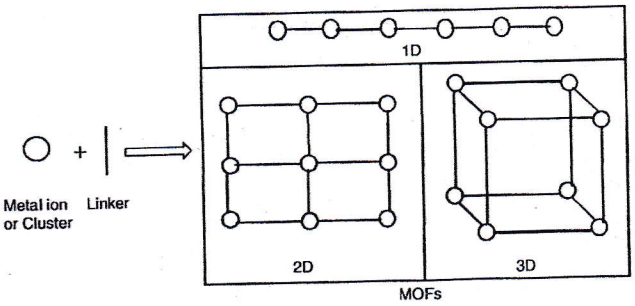

Fig. 1. Schematic representation of a MOF structure

drug delivery, non-linear optics, luminescence, *etc*. [8-18]. Present article provides a review of literature on synthesis and application of MOFs.

Connectors and linkers: For the formation of metal-organic frameworks metal ions (connectors) and organic compounds (linkers) have been used. These are called "Primary Building Units" (PBUs). In some MOFs, metal-oxygen-carbon clusters are applied instead of metal ions alone. These metal-oxygen-carbon clusters are termed as "Secondary Building Units" (SBUs). Generally, 1st row transition metal ions like Cr^{3+}, Mn^{2+}, Fe^{3+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+} are used as connectors in the formation of MOFs [19-35]. In addition, various alkali metal ions [36,37], alkaline-earth metal ions [38-40] and rare