Review

CD-MOFs for Catalytic Applications: Current Research and Future Outlook †

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Abstract: Catalysis is a fundamental process in chemistry and industry, driving the transformation of reactants into valuable products while minimizing energy input and waste generation. The quest for efficient and selective catalysts has led to the emergence of Cyclodextrin Metal-Organic Frameworks (CD-MOFs), a unique class of porous materials combining the advantages of cyclodextrins and metal-organic frameworks. CD-MOFs are gaining recognition for their distinctive capabilities in catalysis, offering benefits in terms of catalytic activity, selectivity, and sustainability. This paper presents an overview of current research on CD-MOFs in catalysis, emphasizing their application as hosts for catalytic materials and as catalysts themselves. The exploration includes studies on the confinement of redox-active monomers within CD-MOFs, resulting in controlled polymerization and enhanced electrical conductivity. Additionally, the paper discusses the encapsulation of photocatalysts in CD-MOFs, leading to stable and active hybrid materials for selective reduction processes. Further investigations delve into the nanoconfined environment of CD-MOFs, showcasing their ability to influence the regio- and stereoselectivity of photodimerization reactions. The synthesis of bimetallic nanoparticles within CD-MOFs is also explored, highlighting their potential in catalytic applications with enhanced stability and recyclability. Despite significant progress, research gaps persist, urging a deeper understanding of the structure-function relationships within CD-MOFs. Mechanistic insights into catalytic processes, scalable synthesis methods, stability under catalytic conditions, recyclability, and diversification of catalytic functions are identified as critical areas for future exploration. The paper concludes by envisioning the future of CD-MOFs in catalysis, emphasizing tailored structures for specific reactions, multifunctionality, sustainability, industrial integration, and the exploration of novel catalytic frontiers in challenging environments. The catalytic prowess of CD-MOFs holds the promise of contributing to sustainable and efficient chemical processes, ushering in a new era of innovation at the intersection of materials science and catalysis.

Keywords: cyclodextrin metal-organic frameworks, catalysis

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