Metal-organic frameworks as support materials in carbon dioxide conversion.

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Organometallic compounds such as pincer complexes have been known to be highly active towards carbon dioxide hydrogenation, while crystal engineering provides the design strategies for anchoring molecular complexes in MOFs. Combining these two areas would offer new materials which are highly active towards the conversion of carbon dioxide. We have utilised pyridylcarboxylate linkers and lanthanides metal ions to produce a number of MOFs. Good CO\textsubscript{2} reduction performance was obtained with some of these compounds, i.e. JMS-1, [La\textsubscript{2}(2,2-bipyridine-4,4-dicarboxylate)\textsubscript{3}(DMF)\textsubscript{3}]\textsubscript{n}, with the new \textit{zaz}-topology functionalized by cyclometallation using [RuCl\textsubscript{2}p-cymene] to produce Ru(II)@JMS-1 displayed outstanding catalytic performance as evidenced by a yield of 98% of formate under optimized conditions of total pressure 50 bar (CO\textsubscript{2}/H\textsubscript{2} = 1:4, temperature 110 °c, time 24 hrs, 5 mmol KOH, 8 mL ethanol) [1].

In a related study, we managed to anchor the palladium (II) catalyst on the nitrogen sites of the linker to create a metalloligand. The Metalloligands was then applied in the synthesis of MOFs as illustrated in Figure 1. The resultant MOF, Pd@JMS-2 showed high catalytic activity for the hydrogenation of CO\textsubscript{2} to formate with TON of above 9000 [2].

![Figure 1. Synthesis of Pd@Mg:JMS-2 and Pd@Mn:JMS-2](image)

Our work demonstrates that the incorporation of molecular catalysts inside the MOF pores enhances the catalytic activity for the conversion of carbon dioxide to formic acid. In a separate approach, we have introduced mesoposity into existing MOFs for the purposes of hosting biological catalysts capable of converting carbon dioxide to methanol.


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