Design and synthesis of novel Lanthanide-based metal-organic frameworks (MOFs) for catalytic hydrogenation of carbon dioxide to formic acid.

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There are worldwide concerns regarding excessive amounts of carbon dioxide in the atmosphere,[1] and many scientists are working on carbon dioxide (CO₂) utilization strategies, making use of novel catalysts to convert carbon dioxide to formate (FA).[2] FA can be used for hydrogen storage, as fuel, and as C1 building blocks for olefins.[3] FA is expected to become an outstanding hydrogen carrier in fuel cells.[4] Metal-organic frameworks (MOFs) have been well-thought-out as promising materials for several applications such as gas storage and separation, catalysis and sensing.[5-10]

Lanthanide-based MOFs are promising catalysis candidates for CO₂ utilisation, producing formic acid which is a great alternative for hydrogen energy storage. Herein, we designed and synthesized a novel lanthanide MOF, and functionalized the MOF with Ir(III), Rh(III), Ru(II), Pd(II) and Pt(II) as pre-catalysts for CO₂ hydrogenation to FA.

Figure 1. a) Geometry around La(III) metal centres in the MOF [La₂(bpdca)₃(2(DMF)2(OAc)²)ₙ, b) One of the pores in the MOF, c) Secondary building unit (SBU).

Catalysis studies showed that Ir(III)@ MOF and Rh(III)@MOF show to be good pre-catalyst candidates for the conversion of CO₂ to formate. The pre-catalysts were thermally and chemically stable and morphology was maintained after catalysis.

7) Schieweck, B. G.et.al. ACS Catalysis 2020, 10 (6), 3890–3894.