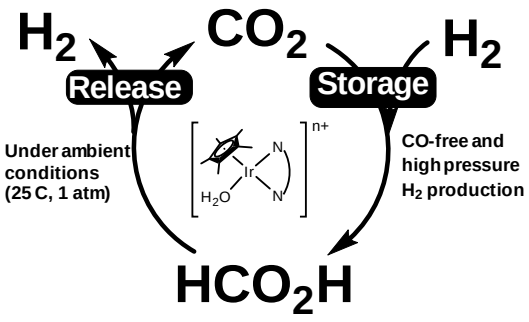
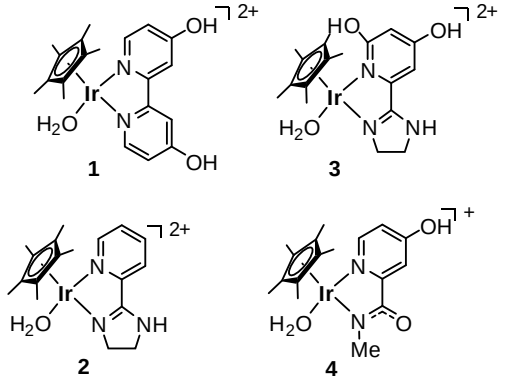
Unterstützt von / Supported by
Alexander von Humboldt
Stiftung / Foundation

Hydrogenation of Cabon Dioxide and Dehydrogenation of Formic Acid for Hydrogen Storage

Yuichiro Himeda*
National Institute of Advanced Industrial Science and Technology, Tsukuba Central 5, 1-1-1 Higashi, Tsukuba, Ibaraki, 305-8565, Japan
himeda.y@aist.go.jp, http://staff.aist.go.jp/himeda.y/

The interconversion between CO_2/H_2 and formic acid (FA) is one of the most promising methods for the development of a hydrogen storage system,[1] because FA is liquid at ambient conditions and contains 4.3wt% and 53 g/L of hydrogen. In general, homogenous catalysts for CO_2 hydrogenation and FA dehydrogenation require an organic solvent or organic additives for efficient reactions. We have developed efficient half-sandwich iridium catalysts for these reactions by modification of the N,N'-bidentate ligands based on our catalyst design concepts. In CO_2 hydrogenation, hydrogen could be converted to formate using proton-responsive catalyst **1** at room temperature and atmospheric pressure in an aqueous bicarbonate solution.[2] Recently, catalysts **3** and **4** produced 0.64 M formate under ambient conditions with efficient catalytic activity. In FA dehydrogenation, we demonstrated continuous H_2 production (up to 0.5 m^3) using catalyst **2** without CO contamination in water for 363 h.[3] In addition, FA dehydrogenation in a closed vessel generated a high-pressure gas mixture using catalysts **1** and **2** (up to 153 MPa).[4] These results show that FA has the potential to be a promising H_2 carrier.





Acknowledgement
This work was supported by JST CREST Grant Number JPMJCR1342, Japan.

References:
(1) Wang et al., *Chem. Rev*. **2015**, *115*, 12936-12973; Hull et al., *Nature Chemistry* **2012**, *4*, 383-388.
(2) Wang et al., *Chemsuschem* **2017**, *10*, 1071-1075; Kanega et al., *ACS Catal*. **2017**, *7*, 6426-6429.
(3) Onishi et al., *Catal. Sci. Technol.* **2016**, *6*, 988-992.
(4) Iguchi et al., *ChemCatChem* **2016**, *8*, 886-890, *Sustainable Energy Fuels* **2018**, dx.doi.org/10.1039/C8SE00087E.