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# FORMIC ACID DISPROPORTIONATION TO METHANOL AND CO<sub>2</sub> REDUCTION

FROM RESEARCH TO INDUSTRY

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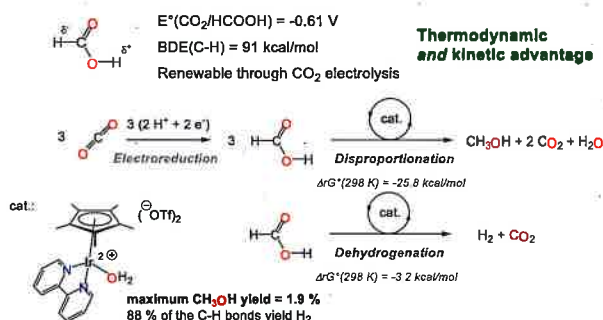
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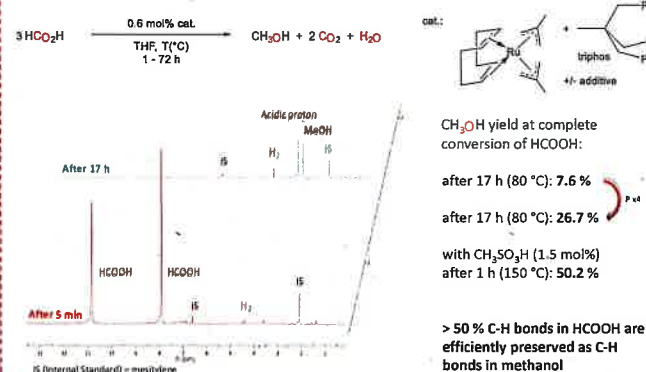
emmanuel.nicolas@cea.fr

CO<sub>2</sub> reduction to formic acid is a well-known process, but non-noble metal catalysts are required to perform this deed in an economically viable way. Moreover, full conversion of CO<sub>2</sub> to methanol is usually difficult for kinetic reasons (simultaneous transfer of 6 electrons and protons). We propose the use of Ru catalysts for formic acid disproportionation to methanol, and the design of new Cu-based catalysts that are capable of CO<sub>2</sub> reduction to the formate level.

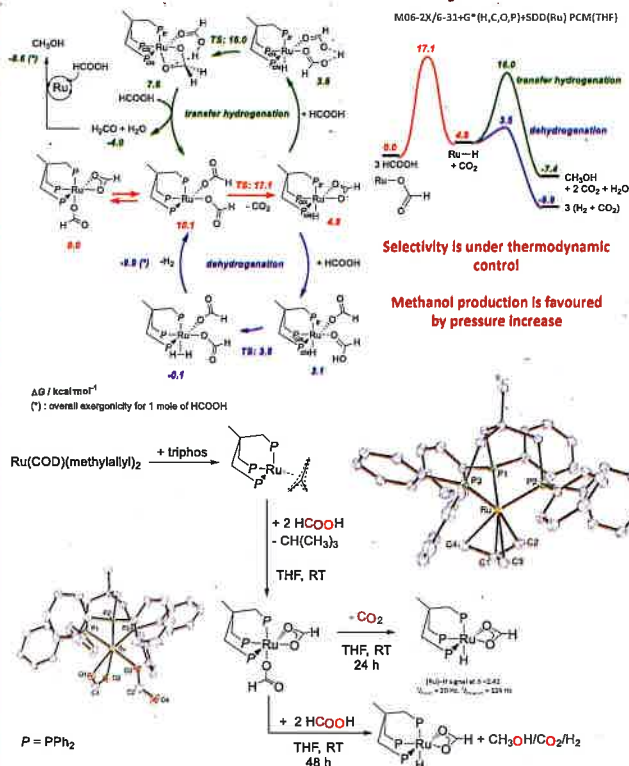
## Concept



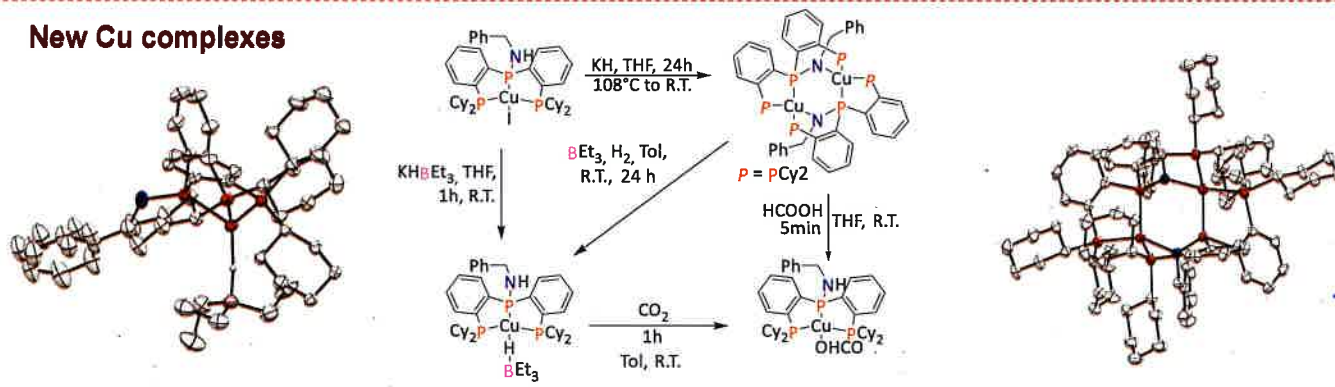
## Catalytic Studies



## Mechanism for Ru catalysts



## New Cu complexes



We demonstrated that a well chosen Ruthenium complex is able to disproportionate formic acid to methanol, with a pressure dependent selectivity. A new hydride copper complex can stoichiometrically reduce CO<sub>2</sub> to formic acid. Further studies to make the system catalytic are on the way in our laboratory.

A. J. M. Miller, D. M. Heinekey, J. M. Mayer, K. I. Goldberg, *Angew. Chemie Int. Ed.* **2013**, *52*, 3981–3984.  
 S. Savourey, G. Lefèvre, J.-C. Berthet, P. Thuéry, C. Genre, T. Cantat, *Angew. Chemie Int. Ed.* **2014**, *53*, 10466–10470.  
 A. Aloisi, E. Nicolas, J.-C. Berthet, P. Thuéry, T. Cantat, *Submitted*