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THE CATALYTIC CARBON DIOXIDE –FORMIC ACID CYCLE FOR HYDROGEN STORAGE AND DELIVERY

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The interconversion of hydrogen and carbon dioxide/carbonates to chemical energy carriers has attracted considerable interest for the development of novel energy technologies, because it combines hydrogen storage and CO2 utilization. Carbon dioxide and carbonates have been proven to be viable H2 vectors, as these widely available natural C1 sources can be easily hydrogenated to formic acid and formates. On the other hand, formic acid can be selectively decomposed into CO free carbon dioxide and hydrogen, H2 gas can be generated very efficiently from formic acid in homogeneous catalytic reactions, using ruthenium and iron catalysts with phosphine ligands.

Summary

Hydrogen is one of the potential candidates as energy vector to replace fossil fuels both for environmental and for economic reasons. H2 has the advantage to form only water when it is burned; and combined with fuel cell technology a very efficient conversion of the chemical energy into electricity can be achieved.
However, the storage and delivery of H2 remains a challenge: conventional hydrogen storage methods like high pressure gas containers and cryogenic liquid containers have weight and safety issues.
Hydrogen can be generated very efficiently from formic acid in homogeneous catalytic reactions, using ruthenium and iron catalysts with phosphine ligands.
On the other hand, the straightforward hydrogenation of CO2 and carbonates leads to the production of formic acid/formate salts, making these system reversible and carbon dioxide neutral process.
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References
[1] C. Fellay, P. J. Dyson, G. Laurenczy, *A Viable Hydrogen-Storage System Based On Selective Formic Acid Decomposition with a Ruthenium Catalyst, Angew. Chem. Int. Ed., 2008, 47, 3966.*
[2] C. Federsel, A. Boddien, R. Jackstell, R. Jennerjahn, P. J. Dyson, R. Scopelliti, G. Laurenczy, M. Beller*; A Well-Defined Iron Catalyst for the Reduction of Bicarbonates and Carbon Dioxide to Formates, Alkyl Formates, and Formamides, Angew. Chem. Int. Ed., 2010, 49, 9777.*
[3] G. Papp, J. Csorba, G. Laurenczy, F. Joó; A Charge/Discharge Device for Chemical Hydrogen Storage and Generation, Angew. Chem. Int. Ed., 2011, 50, 10433.
[4] A. Boddien, D. Mellmann, F. Gärtner, R. Jackstell, H. Junge, P. J. Dyson, G. Laurenczy, R. Ludwig*, M. Beller*, Efficient Dehydrogenation of Formic Acid Using an Iron Catalyst, Science, 2011, 333, 1733.
[5] A. Boddien, C. Federsel, P. Sponholz, D. Mellmann, R. Jackstell, H. Junge, G. Laurenczy, *M. Beller*; A Towards the development of a hydrogen battery, Energy Environ. Sci., 2012, 5, 8907.
[6] M. Grasemann, G. Laurenczy*, Formic acid as hydrogen source –recent developments and future trends, Energy Environ. Sci. 2012, 5, 8171.

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