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CATALYTIC STRATEGIES FOR THE REDUCTION OF C–O BONDS IN CO₂ AND LIGNIN

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ABSTRACT

Besides its utilization as a preservative and antibacterial agent in the agriculture industry, formic acid (FA) is at the crossroads of novel sustainable energy strategies. With a high energy density of 2104 WhL⁻¹, FA is indeed investigated as a potential energy vector as a fuel in electrochemical fuel cells. Additionally, FA is an attractive hydrogen carrier because of its relatively high hydrogen content (4.4 wt%) and “hydrogen batteries” have been proposed, which rely on the reversible hydrogenation of CO₂ and dehydrogenation of formic acid, in basic media, for H₂ storage.^[1] Importantly, efficient catalysts are required to promote the rapid and selective dehydrogenation of FA to CO₂ and molecular H₂ and their design has been the focus of many efforts within the last two decades. While state of the art catalysts are based on metal catalysts (e.g. Ru, Ir and Fe), we have developed the first metal-free catalysts able dehydrogenate formic acid, at low temperature (<150°C). Using well-defined formate boron complexes, H₂ is efficiently produced from FA, with a high selectivity, via the decarboxylation of a formate ligand on boron.^[2]

Formic acid is also considered an attractive intermediate to the formation of methanol (4900 WhL⁻¹).^[3] Capitalizing on the possible generation of hydroborane synthons by decarboxylation of formatoboranes, we have recently demonstrated an unprecedented example of formic acid disproportionation, mediated by an organic compound.

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