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Coupled iron-microbial catalysis for CO_2 hydrogenation with multispecies microbial communities

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Abstract. The hydrogenation of carbon dioxide offers a large range of possible reactions for converting hydrogen to chemical compounds that can be easily stored, transported and used as fuels or platform molecules. In this study, CO_2 hydrogenation was biocatalysed by multispecies microbial communities to produce formate, butyrate and acetate. A hybrid metal/microbial catalysis was pointed out in the presence of iron. Addition of $FeCl_3$ 10 mM increased the production of acetate by 265 % and butyrate by 73 %, to 5.26 and 14.19 g/L, respectively. A stable acetate production rate of 830 mg/L/d was thus sustained for more than 20 days. The presence of iron promoted the selection of Firmicutes and the best performances were linked to the growth of a restricted number of dominant species of two genera: *Clostridium* and *Megasphaera*. Various possible catalysis mechanisms are discussed and guidelines are proposed for further development and scale-up of the process.

Keywords: biocatalysis; gas-liquid; green chemistry; sustainable chemistry; environmental inoculum; electron transfer.