Rewiring *Escherichia coli* for bio-based production of C1 compound from H_2 and CO_2.

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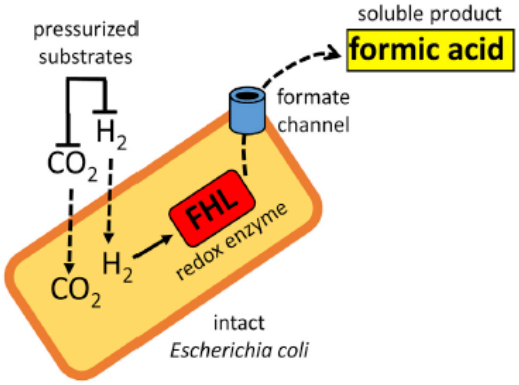

The hydrogenation of CO_2 to formic acid (FA) offers a promising route to greenhouse gas sequestration, H_2 transport and storage, and the sustainable generation of renewable chemical feedstock. Several chemical processes exist for this reaction, but they require the use of expensive catalysts and harsh conditions. In contrast, biological catalysts provide a ``greener" solution for the CO_2 conversion to FA.

The formate hydrogenlyase (FHL) complex from *E. coli* normally catalyzes the disproportionation of FA into H_2 and CO_2. In addition to its role in bio-H_2 production, it has been demonstrated that it can also operate as a H_2-dependent CO_2 reductase (HDCR), paving the way for its exploitation in CO_2 capture technology. By using a bioprocess engineering approach, we recently demonstrated that the FHL can operate as a highly efficient CO_2 reductase under controlled CO_2 and H_2 gas pressure. Using intact cells, the pressurized system converted 100 % of gaseous CO_2 while producing >500 mM FA. To further improve the system, I am seeking to design strains optimized for the HDCR activity during bacterial growth. First, replacing Mo by W in the enzyme inhibits H_2 production while maintaining HDCR activity. Then, placing the expression of the FHL under the control of synthetic promoters allows improvement of the FHL production. Finally, keeping with the synthetic biology approaches already taken, a synthetic CO_2 concentrating pathway inspired by *C. reinhardtii* was incorporated in *E. coli*. The ability of these various engineered cells to fix CO_2 is being assayed.

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