Development of biocatalysts for biomimetic CO2 capture

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Carbonic anhydrase (CA) is an enzyme that catalyzes reversible hydration of carbon dioxide into bicarbonate and proton. It has been recently suggested that this remarkably fast enzyme can be used for sequestration of CO_2, a major greenhouse gas, making this a promising alternative for chemical CO_2 mitigation. For its practical application, we developed efficient and economic biocatalysts with high stabilization, based on large production of a recombinant CA from *Neisseria gonorrhoeae* (*ng*CA) in *Escherichia coli*. First, we engineered *ng*CA in the periplasm of *E. coli* to promote the economical use of enzymes, thereby creating a bacterial whole-cell catalyst. We then investigated the application of this system to CO_2 sequestration by mineral carbonation, a process with the potential to store large quantities of CO_2. Next, we developed and characterized bioinspired silica nanoparticle with auto-encapsulated recombinant *ng*CA. The silica formation was mediated by the silica-condensing R5 peptide fused to the *ng*CA. This bioinspired silica nanoparticle with CA can be efficiently applied to CO_2 sequestration with the outstanding entrapment, catalytic performance, and stability.