Direct CO_2 hydrogenation to formic acid using carbon nitride in neutral conditions

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Formic acid is a molecule that can be synthesized from CO_2 hydrogenation and is considered as a stable and safe H_2 storage medium with a large volumetric hydrogen capacity. Moreover HCOOH is easily decomposed to H_2 and CO_2 on Pd catalysts under mild conditions without CO evolution.

Graphitic carbon nitride is 2 dimension structure. g-C_3N_4 is applied as a support of the Pd catalyst for direct HCOOH synthesis by CO_2 hydrogenation under neutral conditions. The high CO_2 affinity of g-C_3N_4 is responsible for the enhanced catalytic acitivity and stability relative to the inert support such as a carbon nanotube.

The total Pd time yield of 1.4Pd/g-C_3N_4 is 12 times higher than that of Pd/CNT with a similar Pd particle size. Notable, no HCOOH species was detected in the reaction solution when bare g-C_3N_4 was used without Pd. Since H_2 is activated on the Pd surface, HCOOH formation reaction should take place at the interface with g-C_3N_4, where CO_2 activation occurs.