Ionic Liquids as Bifunctional Cosolvents Enhanced CO₂ Conversion Catalysed by NADH-Dependent Formate Dehydrogenase

Efficient CO₂ conversion by formate dehydrogenase is limited by the low CO₂ concentrations that can be reached in traditional buffers. The use of ionic liquids was proposed as a manner to increase CO₂ concentration in the reaction system. It has been found, however, that the required cofactor (NADH) heavily degraded during the enzymatic reaction and that acidity was the main reason. Acidity, indeed, resulted in reduction of the conversion of CO₂ into formic acid and contributed to overestimate the amount of formic acid produced when the progression of the reaction was followed by a decrease in NADH absorbance (method N). Stability of NADH and the mechanism of NADH degradation was investigated by UV, NMR and by DFT calculations. It was found that by selecting neutral–basic ionic liquids and by adjusting the concentration of the ionic liquid in the buffer, the concentration of NADH can be maintained in the reaction system with little loss. Conversion of CO₂ to methanol in BmimBF₄ (67.1%) was more than twice as compared with the conversion attained by the enzymatic reaction in phosphate buffer (24.3%).

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