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Development of Conversion and Storage Methods of Hydrogen Energy into Formic Acid Using Sub- and Supercritical Aqueous Solution of Sodium Chloride

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Summary

Control of the decomposition paths of HCOOH into CO and CO_2 is desired for the utilization of formic-acid intermediate in the water-gas-shift reaction for the production and storage of hydrogen energy. I demonstrated the selective path control of the HCOOH decomposition into CO and CO_2 by taking advantage of the hybrid use of $ZnCl_2$ and NaCl. The NMR analysis shows that $ZnCl_2$ has a catalytic effect on CO_2 path and the catalytic effect can be finely tuned with variation of $ZnCl_2$ concentration. NaCl has an effect to slow down the catalytic effect of $ZnCl_2$ on CO_2 production and can be used to modulate the role of $ZnCl_2$ and to switch the reaction path from CO_2 to CO production. The present procedure can be used to produce HCOOH with minimum loss of decomposition into CO_2 and to produce H_2 from HCOOH with minimum loss into CO.

The procedure developed here can be used for the in selective path control of HCOOH decomposition in hot water with $ZnCl_2$ and NaCl. When HCOOH is produced from CO gas, the reaction rate of the production from CO to HCOOH is desired to be enhanced without accelerating the loss of HCOOH into CO_2, while the decarboxylation of HCOOH needs to be accelerated when H_2 is taken out from HCOOH. The present findings can be used to improve the effectiveness of the control of the competing reaction pathways from HCOOH to CO and CO_2.