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Hydrogen generation from sodium borohydride hydrolysis accelerated by zinc chloride without catalyst: a kinetic study

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ABSTRACT

Sodium borohydride ($NaBH_4$) hydrolysis offers significant advantages in hydrogen storage for fuel cells, but the hydrolysis requires the use of expensive catalysts, such as Ru and Pt alloys, or various supports. To explore low-cost and high activity catalysts, we use $ZnCl_2$ to promote the hydrolysis rate of sodium borohydride. The mechanisms and apparent activation energy of these composites are discussed. Compared to the hydrolysis of pure $NaBH_4$ (523 mL/g hydrogen in 2 h at 298 K), $NaBH_4$ with 20 wt% $ZnCl_2$ has the best hydrolysis performance with the hydrogen generation rates of 844 mL/g in 5 min, 1039 mL/g in 10 min and 1933 mL/g in 2 h at 298 K. The apparent activation energies of $NaBH_4$ hydrolysis decreased from 79.5 kJ/mol in deionized water to 47.7 kJ/mol with the addition of 20 wt% $ZnCl_2$. These results demonstrated that $ZnCl_2$ could be a promising reagent to promote $NaBH_4$ hydrolysis in a hydrogen generation system to replace noble metal catalysts.

Keywords: Hydrogen generation; Sodium borohydride; Hydrolysis; Zinc chloride; Fuel cell