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ABSTRACT:

Mechanochemical Hydrogenation Of Co_2 and Carbonates from Solid Materials under Ambient Conditions

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From the perspectives of both atmospheric CO2 mitigation and carbon utilization, the hydrogenation of CO2 into useful fuels and chemicals has attracted considerable attention. Among the various approaches, CO2 methanation is particularly attractive because it enables the conversion of CO2 into CH4, a widely used fuel. Moreover, since the CO2 released upon the combustion of CH4 can in principle be recycled back into CH4, this process can be regarded as part of a carbon cycle. Based on this concept, many studies have been reported in recent years1. However, conventional CO2 methanation generally requires elevated temperatures above 200 ˚C for kinetical reasons and involves challenges associated with the handling of high-pressure H2 gas. In contrast, from a thermodynamic standpoint, CO2 methanation is more favorable at lower temperatures. In this presentation, we report mechanochemical CO2 methanation as an alternative approach to lowering the reaction temperature and simplifying the reaction system2. In particular, for CO2 methanation using LaNi-based hydrogen storage alloys, we developed a gas-flow type mechanochemical reactor and demonstrated in-situ monitoring of the reacted gas. As a result, CH4 generation was confirmed without external heating. Furthermore, we found that hydrogen (H) dissolved in the alloy accelerates CO2 methanation. Post-reaction analysis revealed that LaNi5 underwent disproportionation into Ni, La-carbonate, La-hydroxides. These results further suggest that the carbonates act as the carbon source for CH4 formation and that hydrogen evolution from hydroxides also occurs3.

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