Project H-10: Catalytically modified hydriding properties of novel complex hydrides

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An investigation of the effect of catalytic additives on the hydrogen sorption properties of complex hydrides is underway at Sandia National Laboratories. This work is being done in collaboration with Professor Yvon at the University of Geneva. Doping with Ti has been shown to be highly effective in enhancing the reversibility of sodium alanates. For the successful development of light-weight hydrogen storage materials it is critical to demonstrate catalytically enhanced decomposition/reformation reactions in other complex hydride systems. The Mg/Fe system is an analog to the alanates and thus a good candidate for evaluated catalytic modifications. MgH_2/Fe compositions were prepared by ball-milling with and without $TiCl_3$ as a catalytic additive. Temperatures of approximately 300ºC were required to fully desorb the MgH_2, both with and without the catalyst. When exposed to a hydrogen pressure of 60 bar, the powders rapidly absorbed hydrogen once the sample temperature was raised to approximately 100ºC. Temperatures rose immediately to as high as 350ºC due to the exothermic hydrogen absorption reaction. The main absorption product was often MgH_2, but XRD phase analysis also showed the formation of small amounts of the complex hydride Mg_2FeH_6. This phase is more stable than $NaAlH_4$ but the fact that it formed through a direct hydriding process from immiscible phases as do the alanates demonstrated that this system and others like it will be valuable in understanding and increasing the performance of catalysts for complex hydrides.

Our future work will concentrate on quantifying the effects of Ti-additives on this system as well as investigating catalytic modifications of other high-capacity complex hydrides.

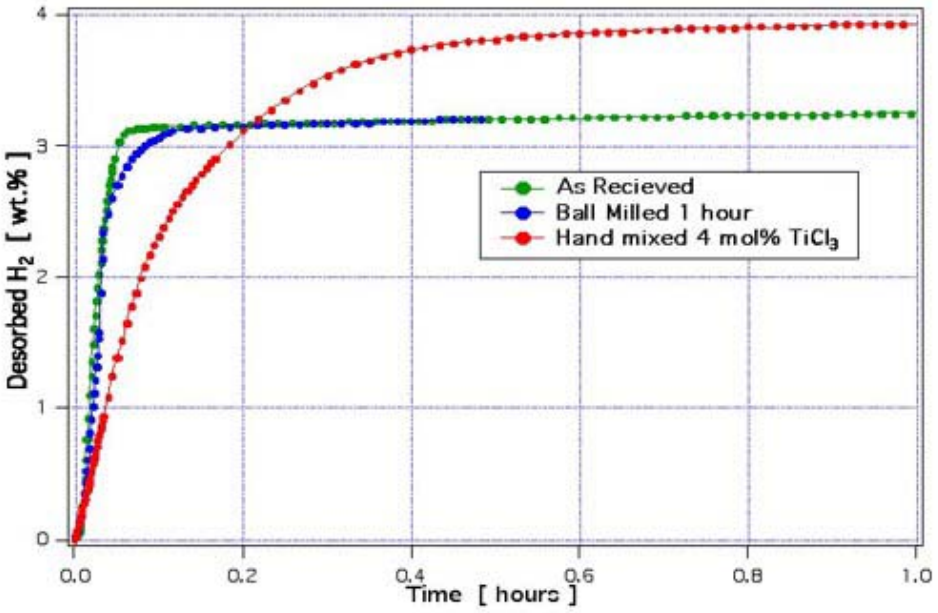

Figure: 2nd desorption, 300°C after 24hr charge at 300°C with 100 atm