Effects of Ball-milling Conditions on Dehydrogenation of $Mg(NH_2)_2$-MgH_2

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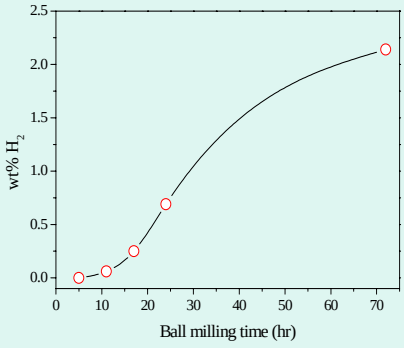
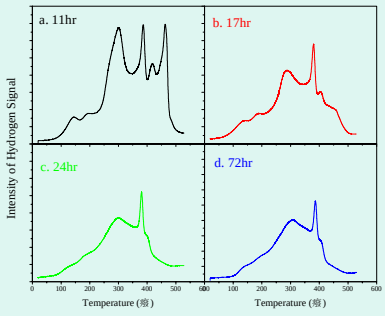
Introduction

By using the affinitive combination of proton cation $H^{\delta+}$ in amide and $H^{\delta-}$ in hydride, successful amide-hydride systems have been developed. Ball-milling is a widespread method in preparing alloys and solid phase mixtures and conducting solid state reactions. In the present work, we prepared the $Mg(NH_2)_2$-MgH_2 mixtures at 1:1 molar ratio using a planetary ball-mill. The effects of milling time on properties of the resulted samples were investigated.

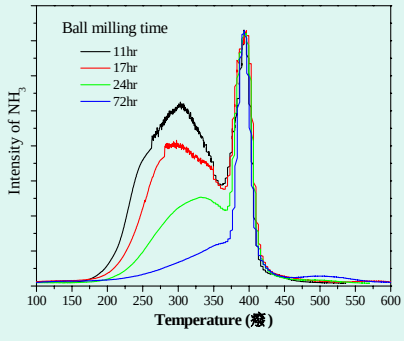
Results



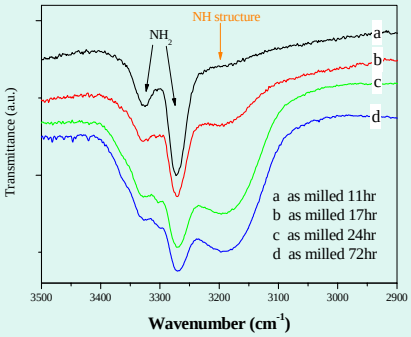
Hydrogen was released during ball milling process at ambient temperature



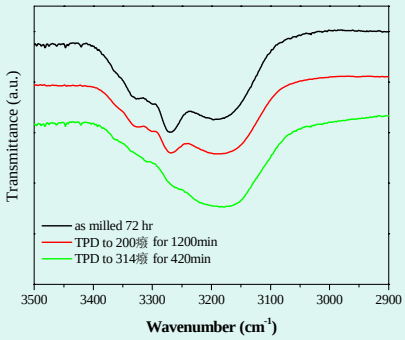
Different Temperature-Programmed-Desorption behaviors with different ball milling time



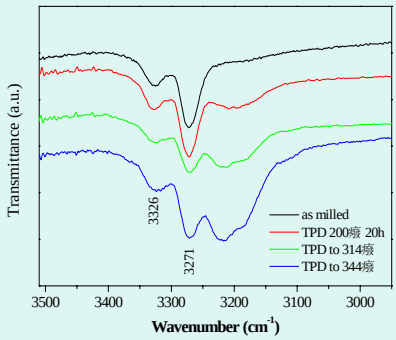
Decrease in NH_3 release in low temperature range with increased ball milling time



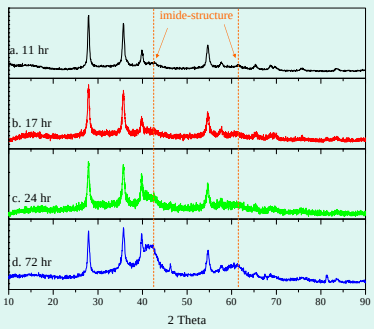
FTIR spectra of samples with different ball mill time: increase in imide with decrease in amide



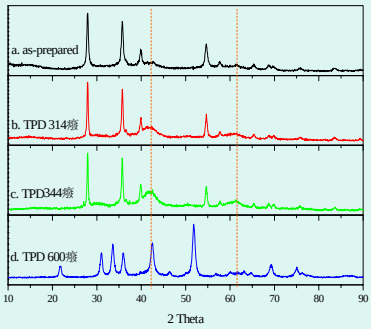
FTIR spectra show formation of Imide-structure for 72hr ball milled sample



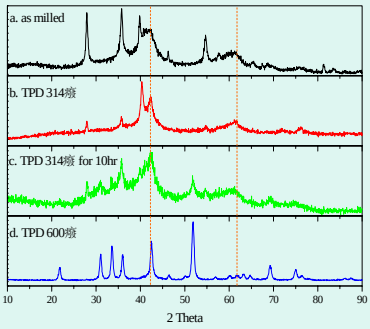
FTIR spectra show formation of imide-structure for 11hr ball milled sample



XRD patterns show effects of ball milling on structure: progressive increase at 41 and 61 of imide-structure



XRD patterns of 11hr milled sample: from imide-structure to Mg_3N_2 with rising temperature



XRD patterns of 72hr milled sample: from imide-structure to Mg_3N_2 with rising temperature

Summary

The ball-milling of $Mg(NH_2)_2$-MgH_2 mixture substantially changed the thermal decomposition behaviors of the individual components. The H_2 release from the amide-hydride reaction could be promoted by thorough ball-milling. The as-prepared samples released H_2 beginning at temperatures as low as 65° C till 310° C with a total amount of 4.8 wt% of H_2 from the investigated system. The hydrogen release process is proposed as follows:

$$Mg(NH_2)_2 + MgH_2 = 2MgNH + 2H_2 \qquad \text{H content} = 4.88\text{wt.\%}$$

References

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[2] Z. T. Xiong, G. T. Wu, J. J. Hu, P. Chen, Adv. Mat., 16 (2004) 1522-1525.
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