MgH_2-TiFe Composite for Hydrogen Storage: Synthesis and Characterization

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MgH_2 - 40wt.% TiFe composites were mechanical alloyed by high-energy ball milling, starting from both compounds, under high-purity argon atmosphere. In this case, the aim was to combine TiFe compound, which absorbs and desorbs hydrogen at or very near room temperature, with Mg, which has higher storage capacity. To avoid or reduce adherence on the vial and balls commercial MgH_2 powder, instead of Mg, was used. TiFe was synthesized following a route described previously [1]. Three sets of experiments were done. In the first and second sets, MgH_2 and TiFe powders were individually pre-milled in a shaker mill for 0.5 and 1 hour, respectively. Both milled powders were further mechanical alloyed in a planetary mill for 6 hours with ball-to-powder weight ratio (BPWR) of 40:1 (first set), or in a shaker mill for 2 hours, with BPWR of 30:1 (second set). In the third set, milling of both powders was conducted only in the shaker mill for 2 and 4 hours. Cyclohexane was used as process control agent in all experiments. DRX analysis showed no reaction between MgH_2 and TiFe compound in all milled samples. Microstructural analysis by SEM revealed that TiFe particle size was 15% lower when pre-milling stage was performed (first and second sets of experiments). In the third set of experiments, TiFe particle size was reduced about 35% comparing milled samples for 2 and 4 hours (shaker mill). PCT and kinetics measurements were carried out in a Sieverts' type apparatus (under constant hydrogen flow) after heating the samples at 623K under vacuum for hydrogen desorption from MgH_2. Results showed a increased hydrogen absorption capacity (about 4 wt % H_2) for samples with lower TiFe particle size, which is accomplished after milling for 4 hours in the shaker mill.

[1] R. B Falcão, E. D. C. C Dammann, C. J. Rocha, R. U. Ichikawa, M. Durazzo, L. G. Martinez, R. M. Leal Neto, Mater. Sci. Forum 802 (2014) 61.