Synthesis by high-energy ball milling of MgH_2-TiFe composites for hydrogen storage

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MgH_2-X wt.% TiFe composites were synthesized by high-energy ball milling in a planetary (X = 40, 50, 60) and shaker mill (X = 40) under high-purity argon atmosphere. Commercial MgH_2 instead of Mg powder was used in order to reduce adherence on the vial and balls. TiFe powder was previously produced by ball milling a mixture of TiH2 and Fe powders followed by a reaction synthesis at 600°C. Milled composites samples were characterized by XRD and SEM analysis. Milling time was preliminary investigated (X = 40) in the planetary ball mill (6 to 36h). TiFe particle size reduction was shown to be difficult since they are surrounded by MgH_2 matrix. Strong particle reduction was obtained by using a shaker mill only for 2 hours and adding cyclohexane as process control agent. No reaction between MgH_2 and TiFe intermetallic was observed in any milled sample. Hydrogen absorption kinetics of the as-milled samples were conducted on an Sievert's type apparatus at room temperature after hydrogen desorption at 350°C under vacuum. The best hydrogen capacity was observed for the sample milled in the shaker mill (4.0 wt.%), but only after 13h.

Keywords: hydrogen storage, ball milling, magnesium hydride, TiFe