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Properties of Magnesium-Based Hydrogen Storage Alloy Added with Palladium and Titanium Hydride

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Abstract : Nowadays, the great majority believe that there is great potentiality in hydrogen storage alloy storing hydrogen by physical and chemical absorption. However, the hydrogen storage alloy is limited by high operation temperature. Scientists find that adding transition elements can improve the properties of hydrogen storage alloy. In this research, outstanding improvements of kinetic and thermal properties are given by the addition of Palladium and Titanium hydride to Magnesium-based hydrogen storage alloy. Magnesium-based alloy is the main material, into which TiH2 / Pd are added separately. Following that, materials are milled by a Planetary Ball Miller at 650 rpm. TGA/DSC and PCT measure the capacity, spending time and temperature of abs/des-orption. Additionally, SEM and XRD analyze the structures and components of material. It is clearly shown that Pd is beneficial to kinetic properties. 2MgH2-0.1Pd has the highest capacity of all the alloys listed, approximately 5.5 wt%. Secondly, there are not any new Ti-related compounds found from XRD analysis. Thus, TiH2, considered as the catalyst, leads to the condition of 2MgH2-TiH2 and 2MgH2-TiH2-0.1Pd efficiently absorbing hydrogen in low temperature. 2MgH2-TiH2 can reach roughly 3.0 wt% in 82.4 minutes at 50°C and 8 minutes at 100°C, while2MgH2-TiH2-0.1Pd can reach 2.0 wt% in 400 minutes at 50°C and in 48 minutes at 100°C. The lowest temperature of 2MgH2-0.1Pd and 2MgH2-TiH2 is similar (320°C), otherwise the lowest temperature of 2MgH2-TiH2-0.1Pd decrease by 20°C. From XRD, it can be observed that PdTi2 and Pd3Ti are produced by mechanical alloying when adding Pd as well as TiH2 into MgH2. Due to the synergistic effects between Pd and TiH2, 2MgH2-TiH2-0.1Pd owns the lowest dehydrogenation temperature. Furthermore, the Pressure-Composition-Temperature (PCT) curve of 2MgH2-TiH2-0.1Pd is measured at different temperature, 370°C, 350°C, 320°C and 300°C separately. The plateau pressure is given form the PCT curves above. In accordance to different plateau pressures, enthalpy and entropy in the Van’t Hoff equation can be solved. In 2MgH2-TiH2-0.1Pd, the enthalpy is 74.9 KJ/mol and the entropy is 122.9 J/mol. Activation means that hydrogen storage alloy undergoes repeat abs/des-orpting processes. It plays an important role in the abs/des-orption. Activation shortens the abs/des-orption time because of the increase in surface area. From SEM, it is clear that the grain size and surface become smaller and rougher

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