On the improvement of hydrogen sorption properties of light alloys by bulk and surface severe plastic deformation techniques

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Hydrogen is considered as an ideal energy carrier for automotive applications and sustainable energy economy in the future. Several methods for H storage, involving as high-pressure gas or low temperature liquid, can hardly be adopted due to security issues and high cost. Hence, efficient chemical storage of hydrogen in light materials in the form of hydride is required. Indeed, the hydrogen storage capacities as hydrides in some metals can be significant. However, improvements are still required with regards to the cyclic sorption / desorption behavior to lower the pressure and temperature of the chemical reactions and accelerate their kinetics. Another important issue is the first hydrogenation (activation), as it has been demonstrated that surface oxides decelerate the first hydrogen absorption even at high temperatures.

Recent researches on metallic hydrides capable of reversibly absorbing hydrogen has proved that severe plastic deformation techniques lead to faster kinetics and easier activation. Indeed, plastic deformation sustained by materials during SPD treatments induces grain size reduction, increased dislocation densities and higher vacancy concentration which are believed to accelerated diffusion. Also, the positive effect of catalysts such as fine oxide particles or controlled doping elements has been demonstrated.

Literature review including hydrogen as fuel, hydrogen storage methods and state-of-the-art of studied chemical hydrides will be presented with a particular emphasis on Mg and Ti based alloys.

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[4] Huot J, Skryabina NY, Fruchart D. Application of Severe Plastic Deformation Techniques to Magnesium for Enhanced Hydrogen Sorption Properties. Metals. 2012;2:329-43.