Influence of High-Pressure Torsion on Hydrogen Storage in Metals Hydrides

Kaveh Edalati

Hydrogen Storage Research Division, WPI International Institute for Carbon-Neutral Energy Research (WPI-I2CNER), Kyushu University, Fukuoka 819-0395, Japan

Despite considerable interest in development of hydrogen as an energy carrier, the design of sustainable, safe and affordable hydrogen storage systems is still a challenging task. Several materials such as Mg, Mg_2Ni, $LaNi_5$ and TiFe, which produce hydrides in the atmosphere of hydrogen, are considered as potential candidates for solid-state hydrogen storage. The main drawbacks of most candidates for the solid-state hydrogen storage systems are that either the dehydrogenation temperature is high such as in Mg and Mg_2Ni, the hydrogenation kinetic is slow such as in Mg, the price is high such as in $LaNi_5$ or the activation for hydrogen absorption is very difficult such as in TiFe.

Our studies show that severe plastic deformation using high-pressure torsion method (Fig. 1) is an effective solution to accelerate the hydrogenation kinetic [1] as well as to activate the hydrogen storage materials at the ambient condition [2,3]. Formation of nanograins and high density of lattice defects is responsible for enhanced hydrogen storage properties by High-Pressure Torsion.

[1] K Edalati, A Yamamoto, Z Horita, T Ishihara, Scripta Mater 64 (2011) 880.

[2] K Edalati, J Matsuda, H Iwaoka, S Toh, E Akiba, Z Horita, Int J Hydrogen Energy, 38 (2013) 4622.

[3] K Edalati, J Matsuda, M Arita, T Daio, E Akiba, Z Horita, App Phys Lett, 103 (2013) 143902.

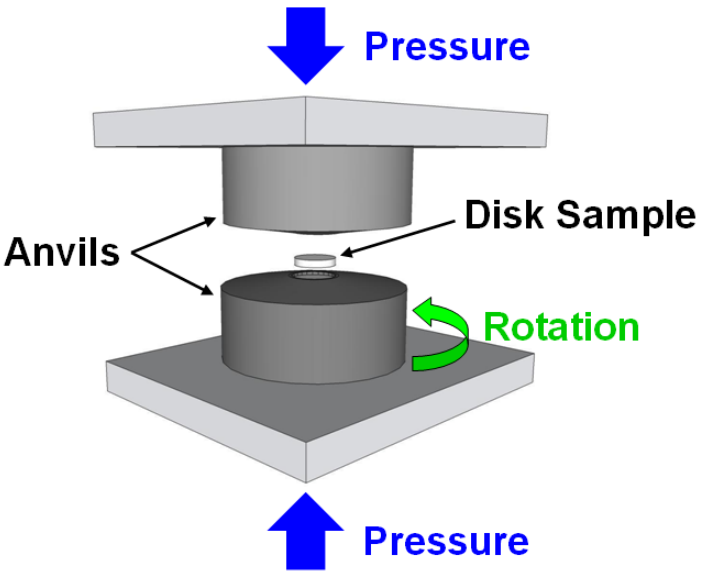

Figure 1. High-Pressure Torsion (HPT) method.