High Pressure Synthesis of New Hydrides with High Hydrogen Content

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Hydrogen storage materials have been receiving many attentions for one of the candidates for hydrogen storage tanks for fuel-cell cars. The Japanese WE-NET programs aims to develop the materials with more than 5.5mass% hydrogen below 150^{o}C. It is proposed that (1) carbon materials or (2) new hydrides with light metals such as NaAlHx, or (3) searching for new hydrides, will achieve their objectives. It already reaches limitations to find the new hydrides in binary alloys or by using conventional techniques as arc-melting.

High-pressure synthesis is one of the promising techniques to explore new metal hydrides. There are two high-pressure techniques such as autoclave technique, which generates high pressure up to 400MPa and cubic-anvil-type technique, which does up to 6-10Gpa, as shown in Fig.1. Most of the works to synthesize new hydrides have been done with autoclave technique, so far. Since the chemical potential of hydrogen increases sharply from around 1Gpa, a cubic-anvil-type technique will be more promising for exploring new hydrides, and also few works using GPa pressure have been reported.

Then, the purpose of our studies is to synthesize new hydrides with high content of hydrogen by using autoclave technique with the pressure range of 2-6 GPa.
We will begin with selecting the alkaline earth– transition metal (AE - TM) system, since volumes of alkaline earth metals such as Magnesium and Calcium elements have been effectively influenced by high pressure as shown in Fig.2. We will also expand our works on rare earth metal - transition metal (RE - TM) systems.

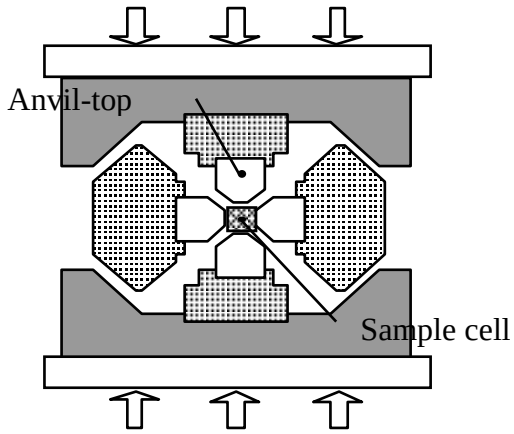

Figure 1
Schematic illustration of cubic-anvil-type apparatus

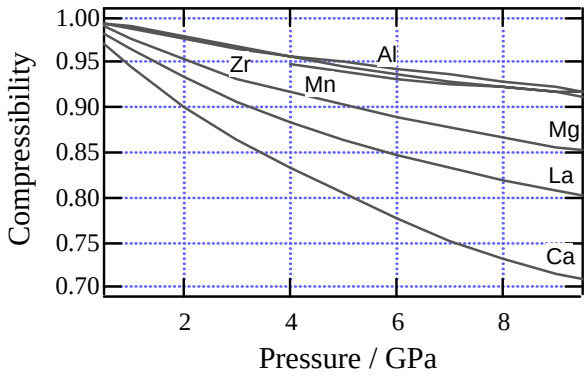

Figure 2
Volume changes of metals by applied high pressure