

Title: Synthesis of Mg based alloys and characterization of hydrogen storage properties

With the fast development of the global economy, the deficiency of fossil fuel resources and the deterioration of ecological environment present a tremendous challenge to long-term development of human society. The research and development of new green energy and energy-saving materials are of great significance. Hydrogen as a clean, efficient and safe source has attracted tremendous attention over the years. As a key Part of the hydrogen-energy utilization, how to store hydrogen efficiently and safely is still a challenging Problem for us until now.

Considering of the safety and storage efficiency, the conventional physical storage devices cannot fulfill the requirement of modern industry any more. But the hydrogen storage material makes it possible to obtain mass and volume capacities higher than those obtained by liquid form or under pressure. Especially the Mg based alloys which have exhibited superiority in the theoretical capacity of hydrogen, characterized by good absorption-desorption dynamics and high security of storage have attracted great attention all over the world. Nevertheless, multi-component alloying brings difficulties to the design of solid solution with high hydrogen storage properties. And thus composition design mostly depends on laborious experimental trials.

Mechanical alloying (MA) is a solid-state powder processing technique involving repeated welding, fracturing, and rewelding of powder particles in a high-energy ball mill. This technique is capable of decreasing crystal size, introducing numbers of grain boundaries and defects, as well as facilitating the formation of nanostructure and amorphous phase.

The purpose of this work is to improve the hydrogen storage properties and reduce the cost of Mg based alloys. The alloys will be synthesized by means of Mechanical alloying. Meanwhile the effect of element addition (like Cr, Mn, V etc.) on the hydrogen storage property of the Mg based will also be investigated.

The research plan is mainly contained the following parts:

- Learn the basic knowledge of the hydrogen storage material and do the literature work about this field,
- Prepare the alloys by the means of Mechanical alloying,
- Analysis the characteristics and the microstructure of the alloys using X-ray diffraction, scanning electron microscope and transmission electron microscope etc.
- Measure the electrochemical hydrogen property of the alloys,
- Compare the result calculated based on the first principles with the experimental result, investigate the mechanism,
- Determine composition of alloys which possess the best property.