

METAL HYDRIDES: FUNDAMENTALS AND APPLICATION OF INTERSTITIAL HYDRIDES

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Metal hydrides nowadays those are called as “classical metal hydrides” have been developed since late 1960’s. The first metal hydride for hydrogen storage was Mg_2Cu ¹⁾ and followed by Mg_2Ni ²⁾. Those alloys are so-called high temperature alloys and the hydrogenation is chemical hydride formation but not interstitial hydride formation. The first “room temperature hydrides” at the same time interstitial hydrides was $LaNi_5$ ³⁾ reported in 1970. Intermetallic compounds for hydrogen storage such as $LaNi_5$ (AB5-type), $TiFe$ ⁴⁾ (AB-type) and Lave phase alloys (AB2-type) were developed in 1970s. In the mid 1990s, Ti based solid solution alloys with BCC structure were developed⁵⁾. Ti based BCC alloys work under ambient conditions and hydrogen capacity is superior than intermetallic compounds.

In 1990, Ni-metal hydride battery was commercialized. $LaNi_5$ based alloys are used for the negative electrode. It is well-known that most of hybrid vehicles are equipped with Ni-metal hydride battery even though Li-ion battery is much popular in other applications.

For most applications including vehicle application, working temperature are near room temperature. Still only “classical metal hydrides” could be used for such applications.

References

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Professor Etsuo Akiba is the Head of Hydrogen Storage Division and the principal researcher of International Institute for Carbon-Neutral Energy Research (I2CNER), and professor of Faculty of Engineering, Kyushu University from December 2010. During his over 35-year carrier, he developed various types of materials including Ti based BCC structured alloys that was used for on board hydrogen storage in the first TOYOTA fuel cell vehicle in 1996. He has determined the crystal structures of novel hydrides using neutron diffraction including $LaNi_5H_3$, $SrAl_2H_2$ and $BaAlH_5$. He received several awards including the Herbert C. Brown Award for Innovations in Hydrogen Research, Purdue University, USA in 2008 and The IPHE Technical Achievement Award in 2010.