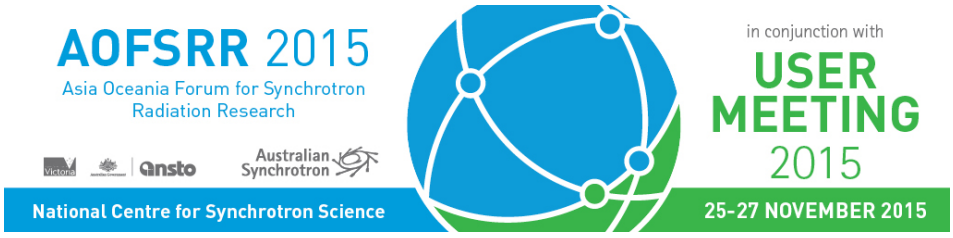

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In-situ hydrogen absorption/desorption behaviour of Mg based alloys

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Hydrogen has the potential to power much of the modern world with only water as a by-product, but storing hydrogen safely and efficiently in solid form such as magnesium hydride remains a major obstacle. Here we use in-situ synchrotron powder X-ray diffraction to investigate the mechanisms of the hydrogen absorption and desorption in bulk Mg-Ni alloys. Our study shows that the hydrogenation of Na-doped hypoeutectic Mg-Ni alloys can be identified at a temperature as low as 260^oC via an interface-controlled nucleation and growth mechanism without any prior activation while dehydrogenation occurrs at about 370^oC. The sequence of phase transformations associated with these reactions as well as the expansion properties of individual phases during hydrogen sorption reactions as provided by high resolution X-ray diffraction data are also discussed. Furthermore, as evidenced by an in-situ ultra-high voltage transmission electron microscopy study, we find that the hydrogen release mechanism from bulk (2 micro;m) MgH2 particles is based on the growth of multiple pre-existing Mg crystallites within the MgH2 matrix, present due to the difficulty of one hundred percent hydrogenation. In contrast, in thin samples analogous to nano-powders, dehydriding occurs by a ‘shrinking core’mechanism.

Keywords

Hydrogen storage, hydrides, magnesium alloys

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