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In-situ X-ray diffraction for hydrogen desorption behaviour of Mg-1wt.% Si alloy

Cast Mg-Si alloys are promising hydrogen storage and transportation media for renewable energy systems due to their low cost, light weight, and non-toxic properties. Phase evolution of Mg-1Si (wt.%) during the hydrogen desorption after the initial absorption was investigated using in-situ synchrotron powder X-ray diffraction (PXRD) at the Australian Synchrotron Powder Diffraction beamline. The Mg-1Si alloy was prepared by permanent mould casting and a trace Na addition (0.2 wt.%) was made prior to the casting to accelerate the initial hydrogen absorption process. The as-cast alloy was mechanically pulverised into fine powder and the powder of the alloy was hydrided at 350 °C, 2 MPa H2 for 20 hours, absorbing 6.72 wt.% H2 using Sieverts-type apparatus. The hydrided powder was then filled into a quartz capillary of 700 μm in diameter. A hot air blower was used to heat the sample from room temperature to 500 °C after the first room temperature scan, and the in-situ PXRD patterns were collected during the H2 desorption between 400 °C to 500 °C. The obtained PXRD patterns were Rietveld refined to acquire the sample compositions. The hydrogen release begins at 430°C and completes at 460°C, mainly associated with the phase change of MgH2 to Mg, while the Mg2Si phase is relatively stable throughout the desorption process. The results indicate that the Mg2Si is not actively involved in the hydrogen sorption process, but a high density of interphase boundaries between Mg/MgH2 and Mg2Si may serve as hydrogen diffusion pathways, improving the H2 sorption kinetics of the alloy.

Level of Expertise

Early Career <5 years

Presenter Gender

Man

Pronouns

He/Him

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