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Hydrogen Absorption by YNi_5 , LaPt_5 ,
and ThNi_5 Intermetallics

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Lawrence Livermore Laboratory has capabilities in hydriding metals at pressures not obtainable at most laboratories.¹ Because of this capability, Dr. Tako Takeshita solicited Lawrence Livermore Laboratory to hydride 3 alloys, YNi_5 , LaPt_5 , and ThNi_5 at pressures above those reported in the literature. These alloys were reported to absorb no significant H_2 at low pressures. The alloys were prepared by him at the Ames Laboratory in Iowa.

YNi_5

Takeshita et al.² had previously investigated the $\text{YNi}_5\text{-H}_2$ system and found that YNi_5 did not absorb hydrogen under the applied pressure of up to 150 atm. Los Alamos Scientific Laboratory investigators³ found the maximum composition at 130 atm to be $\text{YNi}_5\text{H}_{4.4}$. The plateau pressure was 12 atm at 23°C.

LLL results for hydrogen absorption by YNi_5 up to 1550 atm at 21°C are shown in Fig. 1. We show two distinct plateaus, one at 300 atm and one at 1000 atm. The maximum composition at 1550 atm was $\text{YNi}_5\text{H}_{3.5}$. For this alloy and for the other two, more work is necessary to determine whether there is continuous absorption to a maximum of 9¹ atoms of H/mol or whether there are upturns in the isotherms at composition less than 9.

LaPt₅

Los Alamos investigators³ found previously that the maximum composition at 130 atm to be LaPt₅H_{2.3}. The plateau pressure was 130 atm at 23°C.

Our isotherm for LaPt₅ is shown in Fig. 2. The maximum composition reached was LaPt₅H₄ at 1350 atm. We found 3 plateaus; one each at 200 atm, 620 atm, and 1050 atm. There are no signs of an upturn in the plateau at the highest pressure reported.

ThNi₅

The compound ThNi₅ reacts to form ThNi₂H₂ at an atomic ratio of H/M of 0.70.⁴ Takeshita et al.² found that ThNi₅ did not absorb hydrogen gas under the applied pressure up to 150 atm.

One LLL experiment with ThNi₅ showed no plateaus. The experiment was carried to 1350 atm and a composition of ThNi₅H_{4.6} was found. There was no indication of an upturn in the 21°C isotherm.

None of the three alloys were activated with repeated hydrogenation and dehydrogenation prior to collecting data for the actual isotherm. Repeat runs would indicate whether additional hydrogen can be absorbed. X-ray diffraction analysis is also needed to detect any disproportionation of the alloy after each hydriding step.

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Fig. 1. YNi_5 21°C H_2 Absorption

Fig. 2. LaPt_5 21°C H_2 Absorption

Fig. 3. ThNi_5 21°C H_2 Absorption