The Solution of Hydrogen in LaNi_5 at Low Hydrogen Concentrations

LaNi_5 -H系の低濃度領域における水素溶解反応

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Introduction

A great deal of work has been reported on the characteristics for the LaNi_5 -H system since the LaNi_5 alloy was discovered at Philips Research Laboratory in the Netherlands in 1970. However, only several studies have reported the P-C-T measurement for the H solid solution region if this system. The measurement at lower pressures and lower concentrations becomes essentially difficult^{1,2}. Previously, we found that small changes in stoichiometry and residual density of defects have marked influence on the P-C-T characteristics³. Recently, we pointed out that different sample size has large influence on hydrogen solubility⁴. In this investigation, we measured the P-C-T relations for the LaNi_5 -H system using 8 type sample sizes, and examined the effect of the accumulation of internal stresses on hydrogen solubility in LaNi_5 .

Experimental

The P-C-T relations were measured using a Sieverts' type apparatus. The samples employed in this work was stoichiometric $\text{LaNi}_{5.02 \pm 0.05}$. The size of samples used was ranged from 10.5, 9, 7, 3 to 1mm in the side lengths of cubic blocks, and from 100-127 μm , 50-64 μm to smaller than 50 μm corresponding to 20 μm median particle size of powder samples. These samples were annealed in a vacuum of $3 \times 10^{-4} \text{Pa}$ at 1073K for 24h. H_2 pressure was ranged from 10^2 to 10^5Pa . The sample temperature was changed between 373K and 773K. The details of measurement methods are reported elsewhere³.

Results

Figure.1 shows typical P-C-T relations of LaNi_5 -H system for 573K. The measured isotherms obey Sieverts' law at low hydrogen concentrations. With increasing hydrogen concentrations, positive deviation from Sieverts' law can be seen. Then, the marked dependence of hydrogen solubility upon the

sample size can be clearly seen. The hydrogen solubility becomes increased as the sample size is decreased. However, the hydrogen solubilities become independent of the sample size as the sample size becomes the larger than 9mm in the side length of cubic block samples or smaller than 50-64 μm in the particle size of powder samples. In order to confirm the effect, XRD analyses were made for a block and powder sample. Then the volume expansion of the powder sample exhibited higher than that of the block sample. This means that the different solubilities exhibited by the different sample size are not caused by surface effects but may be caused by an intrinsic volume effect.

Fig.1.P-C-T relation of LaNi_5 -H system at 573K

References

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