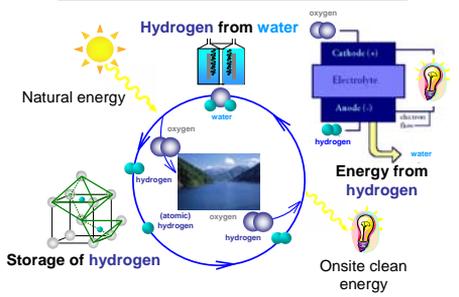


Hydriding properties of the mechanically deformed Mg-Ni alloys

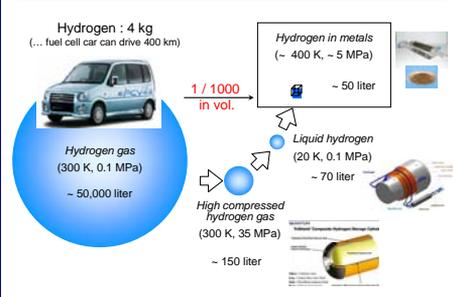
Introduction

Hydrogen is a promising renewable energy in the near future. Mg-Ni alloys are expected to be lightweight hydrogen-storage materials. The aim of this work is to clarify the close relation between the nanometer-scale structural properties and the hydriding properties of the alloys Mg-33, 38, 43 and 50 at.%Ni in which the different amounts of the amorphous MgNi (*a*-MgNi) were partially dispersed around the nanocrystalline Mg₂Ni (*n*-Mg₂Ni). Furthermore, investigations on a-MgNi-based system for clarifying the effect of the short-range ordering on the hydriding properties are studied in detail.

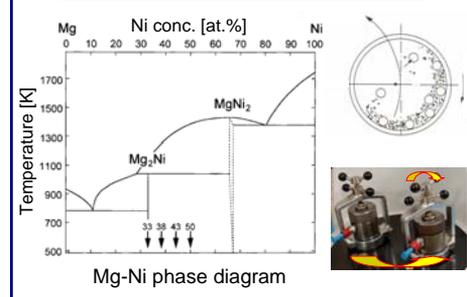
Hydrogen energy cycles



Hydrogen storage techniques

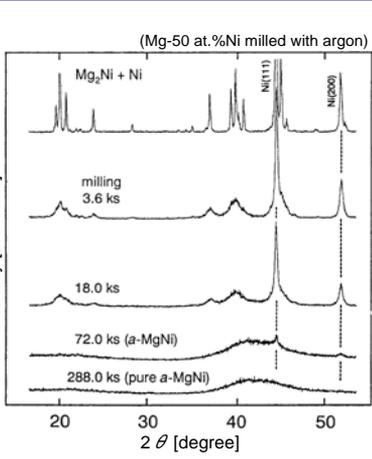
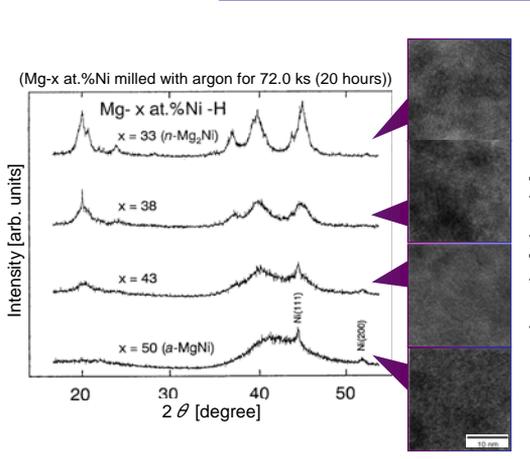


Experimental procedures



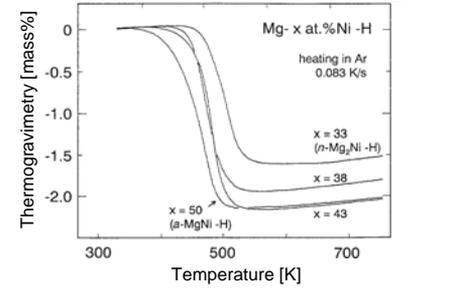
Results and discussion

Mg-33, 38, 43 and 50 at.%Ni with mechanically deformed structures



The coordination numbers *n* and interatomic distances *r* of the Mg-D and Ni-D correlation in MgNiD_{1.6}.

	<i>n</i>	<i>r</i> [nm]
Mg-D	2.3 ± 0.3	0.218(3)
Ni-D	1.7 ± 0.3	0.164(3)

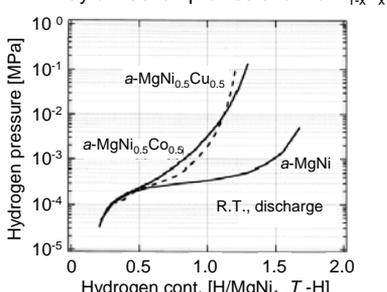
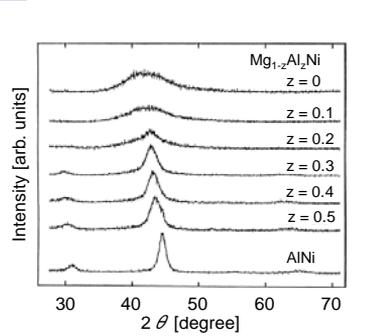
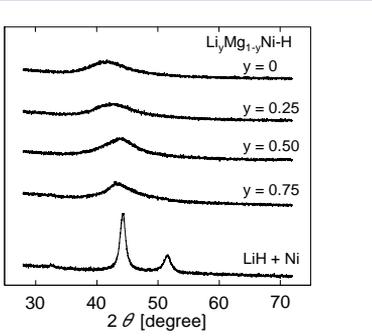
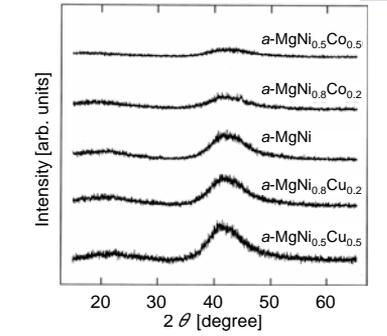


X-ray diffraction profiles and TEM images of Ma-x at.%Ni-H.

X-ray diffraction profiles of Mg-50 at.%Ni.

Thermogravimetric profiles of Mg-x at.%Ni.

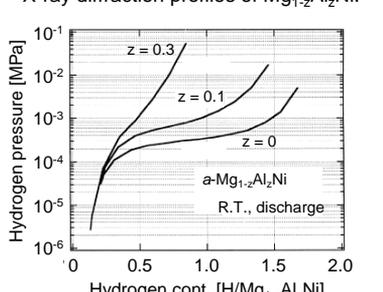
Substitution effects on the hydriding properties



Calculated enthalpies of hydride formation (kJ/molH) of a-MgNi_{0.5}T_{0.5}, assuming that hydrogen occupies the 2Mg1Ni1 T site.

	$\Delta H(a-MgNi_{0.5}T_{0.5}H_2)$	$\Delta H(MgH_2)$	$\Delta H(Ni_{0.5}T_{0.5}H)$	$\Delta H(a-MgNi_{0.5}T_{0.5})$
T = Co	-13	-37	+19	-26
T = Ni	-20	-37	+12	-26
T = Cu	-4	-37	+29	-20

The enthalpy of hydride formation of a-MgNi_{0.5}T_{0.5} by the rule of reversed stability:

$$\Delta H(a-MgNi_{0.5}T_{0.5}H_2) = \Delta H(MgH_2) + \Delta H(Ni_{0.5}T_{0.5}H) - (1-\psi)\Delta H(a-MgNi_{0.5}T_{0.5})$$


Orimo, Fujii, Ikeda: *Acta Mater.* 45 (1997) 331.
Orimo, Ikeda, Fujii, Fujikawa, Kitano, Yamamoto: *Acta Mater.* 45 (1997) 2271.

Ikeda, Orimo, Züttel, Schlapbach, Fujii: *J. Alloys Comp.* 280 (1998) 279.
Orimo, Ikeda, Fujii, Saruki, Fukunaga, Züttel, Schlapbach: *Acta Mater.* 46 (1998) 4519.

Conclusions

The *n*-Mg₂Ni was obtained by milling only Mg₂Ni (x = 33). The *a*-MgNi was partially formed by milling of Mg₂Ni with additional Ni (x = 38 and 43), and was homogeneously formed in equivalent composition (x = 50). The electrochemical *p-c* isotherm measurements revealed that there is obviously the miscibility gap (plateau) pressure higher than 1 × 10⁻⁴ MPa at ambient temperature even in the amorphous phase. The single amorphous alloy is formed for MgNi_{1-x}T_x with T = Co and Cu and x = 0 ~ 0.5. The *p-c* isotherms indicate that the energy levels for hydrogen become partially unstable by the substitutions.