



HAL
open science

The effect of Mn content on structural and sorption properties of the combined AB₃ and A₂B₇-type phases in the La-Y-Ni-Mn system

G Fedloul, J Monnier, L. Laversenne, J Zhang

► **To cite this version:**

G Fedloul, J Monnier, L. Laversenne, J Zhang. The effect of Mn content on structural and sorption properties of the combined AB₃ and A₂B₇-type phases in the La-Y-Ni-Mn system. 18th International Symposium On Metal-Hydrogen Systems, Fermin Cuevas - ICMPE, May 2024, Saint-Malo, France, France. hal-04567421

HAL Id: hal-04567421

<https://hal.science/hal-04567421>

Submitted on 3 May 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Open licence - etalab

The effect of Mn content on structural and sorption properties of the combined AB_3 and A_2B_7 -type phases in the La-Y-Ni-Mn system.

G. Fedlounk¹, J. Monnier¹, L. Laversenne² and J. Zhang¹

¹ Univ Paris Est Creteil, CNRS, ICMPE, UMR 7182, 2 rue Henri Dunant, 94320 Thiais, France

² Institut Néel, CNRS, 25 Av. des Martyrs, 38042 Grenoble, France

ghofrane.fedlounk@cnrs.fr

In recent years, new intermetallic compounds AB_y ($2 \leq y \leq 5$, A being a rare earth or Mg and B a transition metal) have emerged in the field of solid hydrogen storage [1]. These compounds have inter-growth structures, which corresponds to the stacking of two basic units $[AB_5]$ and $[A_2B_4]$ along the crystallographic c -axis [2]. According to the literature, AB_3 -type compounds provide higher hydrogen storage capacity than A_2B_7 -type compounds because they contain more $[A_2B_4]$ units. For the same reason, their cyclability is worse than that of A_2B_7 -type compounds. Therefore, uniting both A_2B_7 and AB_3 structures in the same alloy could be interesting for hydrogen storage.

Apart from the crystallographic structure, playing on the chemistry is also a key point to optimize properties. For example, the rare earth-based binary AB_y alloys exhibit multi-plateaus behavior and poor reversibility which makes them unsuitable for application. The substitutions, notably of A by Mg, but also of B by Mn or Co, reduce the number of plateaus to a single plateau [3, 4]. However, due to magnesium's high evaporation pressure and high reactivity to air, the synthesis can be difficult especially at an industrial scale. Therefore, we are interested in magnesium-free compounds with stacking structure AB_y ($3 \leq y \leq 3.6$), and particularly the $(La,Y)(Ni,Mn)_y$ system.

The present work shows the study of the substitution of Ni by Mn in $LaY_{2.3}Ni_{11.5-x}Mn_x$ ($0.3 \leq x \leq 2.5$) compounds. 8 alloys containing 3 different phases ($A_2B_7 H$, $A_2B_7 R$ and $AB_3 R$) were synthesized and studied. We noticed that the lattice parameters of the phase $AB_3 R$ do not vary linearly with Mn content which indicates a non-random distribution of Mn atoms over different sites (Figure 1). Therefore, a neutron analysis at ILL was conducted on these compounds. Their sorption properties were also investigated, and an increase of the maximum hydrogen storage capacity with increasing of Mn content was observed; up to 2 wt% for $LaY_{2.3}Ni_{9.4}Mn_{2.1}$. The correlation between the structure and hydrogenation properties of these compounds will be presented.

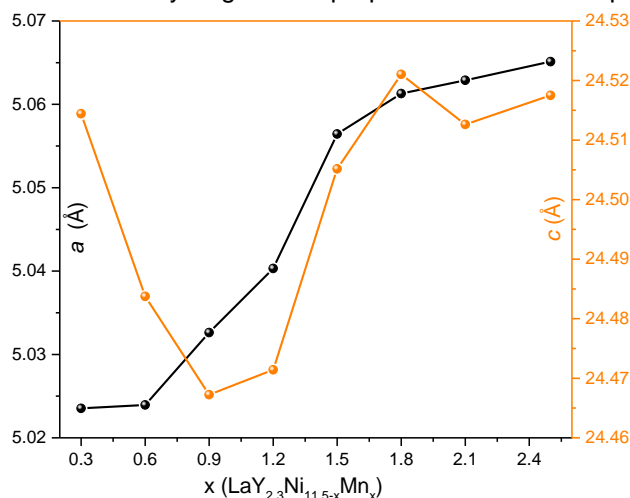


Figure 1 Evolution of lattice parameters of $AB_3 R$ phase in $LaY_{2.3}Ni_{11.5-x}Mn_x$ ($0.3 \leq x \leq 2.5$) alloys as a function of Mn content

References

- [1] Z. Chen *et al*, Chinese Journal of Chemical Engineering, vol. 29 (2021), 1-12.
- [2] J.-C. Crivello *et al*, The Journal of Physical Chemistry C, vol 115 (2011), 25470-25478.
- [3] J. Zhang *et al*, Journal of Alloys and Compounds, vol 852 (2021), 157008.
- [4] Y. Shi *et al*, Electrochimica Acta, vol 296 (2019), 18-26.