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► **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

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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.

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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.

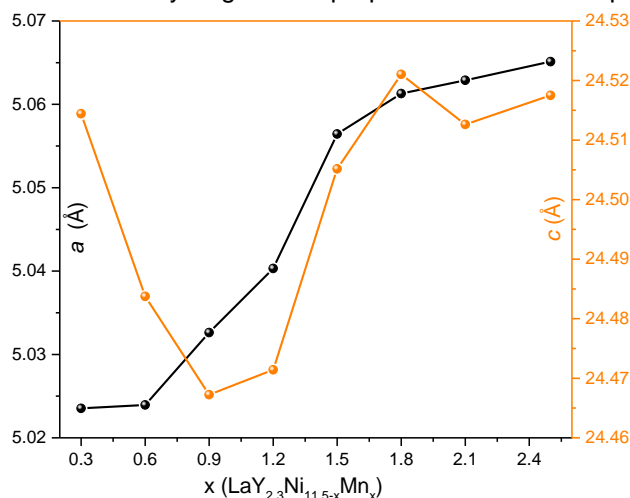


Figure 1 Evolution of lattice parameters of $AB_3 R$ phase in $LaY_{2.3}Ni_{11.5-x}Mn_x$ ($0.3 \leq x \leq 2.5$) alloys as a function of Mn content

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