Intermetallic compounds for hydrogen storage and purification systems integrated with fuel cell power units

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Problem of hydrogen supply of low-temperature fuel cell-based power devices has no satisfactory solution. One way to solve this problem is using hydrogen stored in intermetalic compounds. These compounds provide hydrogen of high purity and permit to do not use the mechanical compression, because hydrogen desorption pressure strongly depend on temperature (enthalpy of hydrogen desorption is high).

To use waste heat from a fuel cell it is supposed to use temperature range from 293 to 353 K (20 and 80°C respectively). LaNi5-based alloys are selected for hydrogen-storage subsystem and hydrogen purification subsystem because of high hydrogen storage capacity, high enthalpy of the hydriding/dehydriding process and long cycle life.

Alloy for hydrogen purification subsystem must have high hydrogen desorption pressure at 353 K to charge hydrogen storage subsystem and low absorption pressure to minimize hydrogen losses during purification process.

Fuel cell requires hydrogen supply at pressure of 6 atm, that's why an alloy for hydrogen storage subsystem must have desorption pressure more than 6 atm at the 353 K along the whole desorption plateau. Also dehydriding process enthalpy must be as greater as possible to make absorption easier.

Several of intermetallic compound compositions with appropriate properties has been calculated using mathematic modeling, synthesized and investigated. Basing on the results optimized compositions were suggested and synthesized.

As the result of investigation $La_{0.5}Nd_{0.5}Al_{0.1}Fe_{0.4}Co_{0.2}Ni_{4.3}$-alloy for hydrogen storage subsystem and $LaFe_{0.1}Mn_{0.3}Ni_{4.8}$-alloy for hydrogen purification subsystem are chosen. Properties of these alloys are shown in the table 1 and PCT-isotherms are shown on figure 1.

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Table 1

Alloy composition	**Equilibrium pressure of hydrogen desorption, atm**		**Hydrogen storage capacity, wt %**		**ΔH_{des}, kJ/mol H**
	298 K	**353 K**	**298 K**	**353 K**	
$La_{0.5}Nd_{0.5}Al_{0.1}Fe_{0.4}Co_{0.2}Ni_{4.3}$	1,1	11,6	1,1	1	35,3
$LaFe_{0.1}Mn_{0.3}Ni_{4.8}$	0,66	7,60	1,3	1,2	40,4

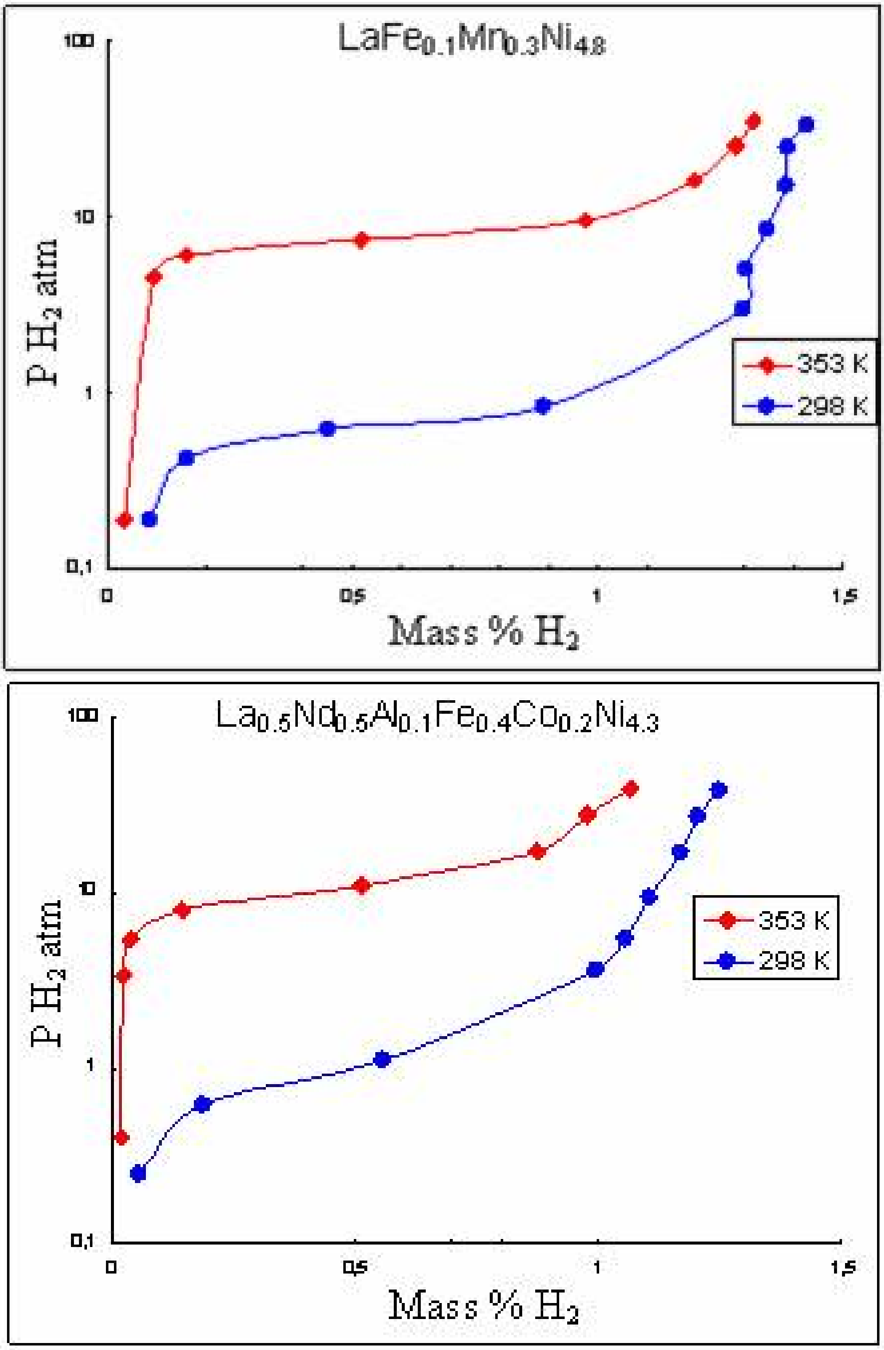

Figure 1. PCT diagrams for developed alloys