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Pressure cycling system for intermetallic hydrides

E. S. Ribeiro1, V. F. Domingos1 and J. M. Gil1*

CEMDRX, Department of Physics, University of Coimbra, P-3004-516 Coimbra, Portugal

(*) jmgil@fis.uc.pt

Introduction

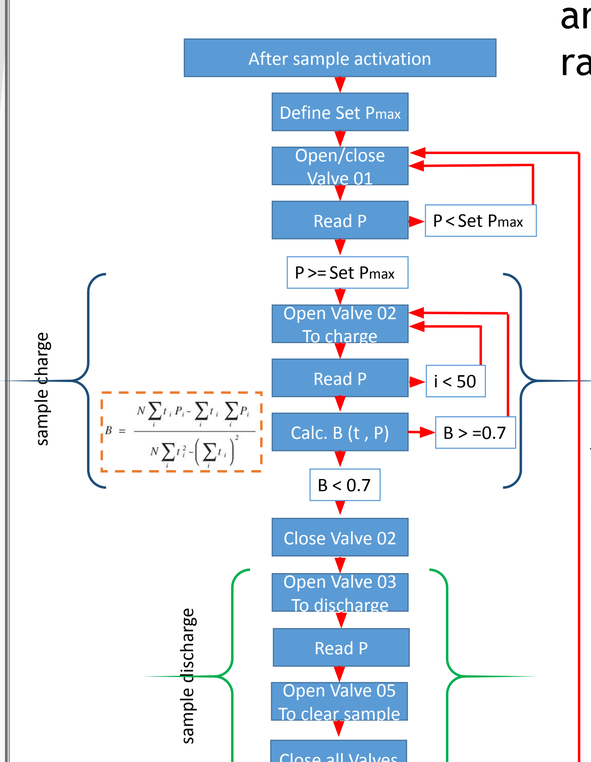
Although intermetallic hydrides are not the best option for storing hydrogen in automotive applications due to their high gravimetric density, they are well suited for stationary applications, where storage of hydrogen as an energy carrier may constitute a major step towards energy autonomy when using renewable sources in micro generation systems.

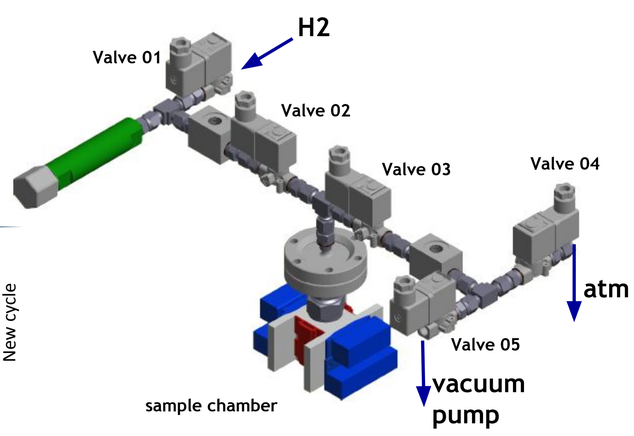
With this objective in mind, our research group is currently designing a hydrogen storage system based on intermetallic hydrides. One important parameter in the evaluation of the performance of such a system is the useful life-time of the hydride bed. This can be studied by pressure cycling a sample of the hydride (see e.g. ref. [1]).

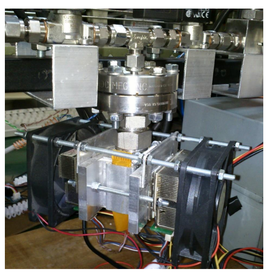
Pressure cycling system

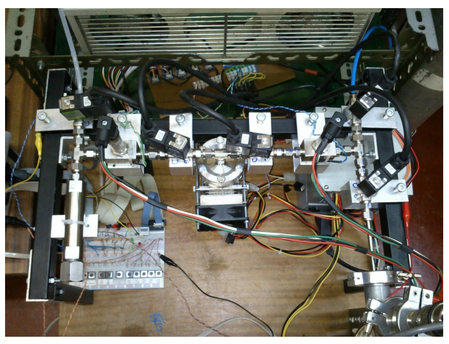
The pressure cycling system is composed of three volumes separated by electro valves that allow the successive expansion of known amounts of hydrogen gas from a reference calibrated volume to the sample chamber and from the latter to a second reference volume.

The sample temperature and the pressures in the reference volumes are constantly monitored and their values are registered at a chosen time rate in a desktop computer.





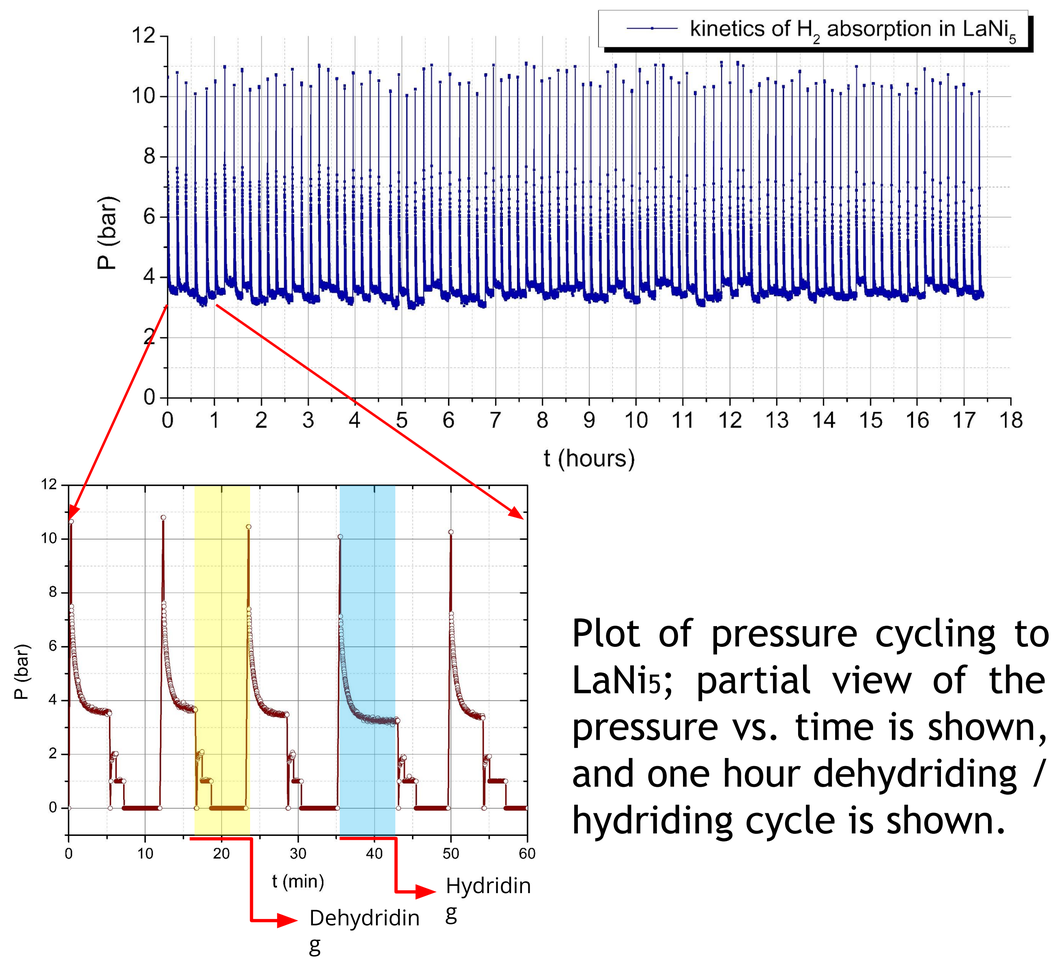




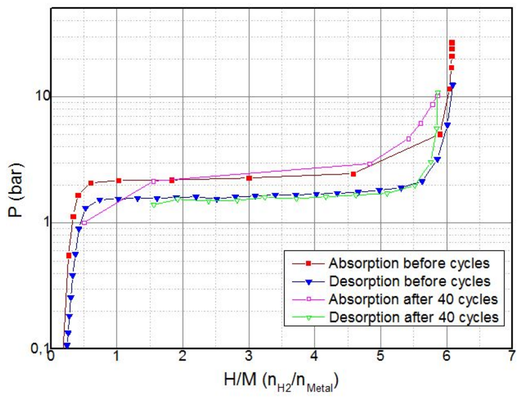
The sample chamber is equipped with heating and cooling devices useful for hydride activation or as a means of controlling the sample temperature within a range from -10°C and 130°C.

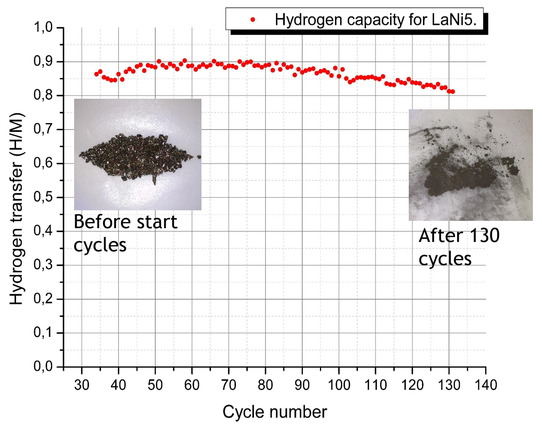
Partial results

A different parameter relevant to the degradation of hydriding properties of an intermetallic compound is related to the changes in the shape of the absorption / desorption isotherm curves.



Plot of pressure cycling to $LaNi_5$; partial view of the pressure vs. time is shown, and one hour dehydriding / hydriding cycle is shown.





The hydrogen capacity loss as function number of pressure cycles for LaNi5.

This systems allows the measurement of isotherms at any given point of the cycling procedure: a crude absorption isotherm is obtained by allowing smaller amounts of gas to expand from the first reference volume to the sample chamber and successively increase the equilibrium pressure, while a desorption curve is obtained by expanding from the sample chamber to the second reference volume in successively lower equilibrium pressure steps.

Acknowledgements

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References

[1] D. Chandra, Intermetallics for Hydrogen Storage, in Gavin Walker (ed.), *Solid-state Hydrogen Storage; Materials and Chemistry*, Woodhead Publishing, Cambridge, 2008