# Mechanical activation of TiFe for hydrogen storage: ball milling x cold rolling

Ricardo Mendes Leal Neto[1], Luis Esteban Romero Vega[2], Railson Bolsoni Falcão[3], Daniel Rodrigo Leiva[4], Cláudio José Rocha[3], Tomaz Toshimi Ishikawa[4], Claudio S. Kiminami[4], Walter José Botta[4]

[1]Instituto de Pesquisas Energeticas e Nucleares, [2]Programa de Pós-Graduação em Ciência e Engenharia de Materiais (UFSCar), [3]Instituto de Pesquisas Energeticas e Nucleares (*Centro de Ciência e Tecnologia de Materiais*) , [4]Universidade Federal de São Carlos (*Departamento de Engenharia de Materiais*)

*e-mail: lealneto@ipen.br*

The aim of this work is to report some recent developments on the synthesis of TiFe by high energy ball milling and cold rolling, concerning hydrogen storage. Ball-milled TiFe was produced by two procedures, both under inert atmosphere and with various milling times. In the first one a powder mixture of $TiH_2$ an Fe was milled, followed by a vacuum heat treatment to promote the reaction synthesis of TiFe compound [1]. Second procedure consisted of milling Ti and Fe powders with stearic acid (as a process control agent) after a pre-milling operation (with the same powders and without PCA) to prepare the surface of milling media. Both methods were conceived for avoiding strong adherence of the powders to the milling balls and vial, impairing the mechanical alloying. Cold rolling was performed on a ground TiFe ingot produced by arc melting [2]. After 20 to 40 passes under inert atmosphere, powder particles and thin cracked flakes were produced.

Results showed that both milling procedures succeeded in avoiding unacceptable adherence to the milling media, with high loose powder yields. Whatever the route, nanostructured TiFe was obtained with no need of further thermal activation for the first hydrogenation. Hydrogen absorption capacities of about 1.0 wt% at room temperature was obtained with both milling procedures. Higher capacity (1.4wt%) was obtained with cold rolled TiFe (powder and flakes) after 40 passes. Some possible explanations for this difference are presented and discussed.

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References:

[1] R.B. Falcão, E.D.C.C. Dammann, C.J. Rocha, M. Durazzo, R.U. Ichikawa, L.G. Martinez, W.J. Botta, R.M. Leal Neto. Int. J. Hydrogen Energy, 43(2018) 16107.

[2] L.E.R. Vega, D.R. Leiva, R.M. Leal Neto, W.B. Silva, R.A. Silva, T.T. Ishikawa, C.S. Kiminami, W.J. Botta. Int. J. Hydrogen. Energy, 43 (2018) 2913