Supporting Information

Efficient Thermal Processes using Alternating Electromagnetic Field for Methodical and Selective Release of Hydrogen Isotopes

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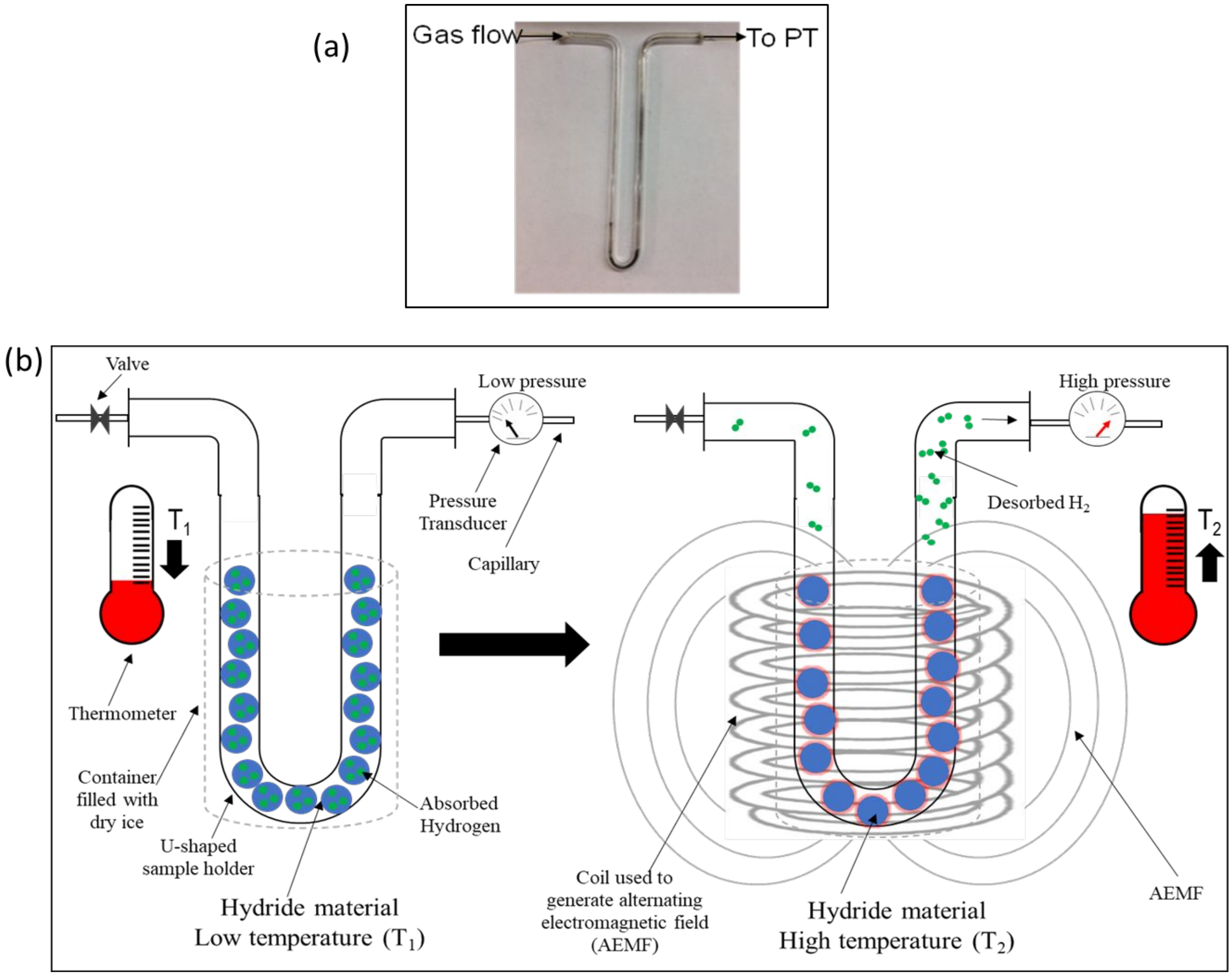

Figure 1 - SI. (a) Photograph of LANA in a U-shaped quartz sample holder showing gas flow; (b) Illustration of the efficient thermal process using alternating electromagnetic field for methodical and selective release of hydrogen isotopes.

A control study was completed with helium gas and compared with hydrogen gas, to evaluate material's hydriding properties. Specifically, the effect of gas composition, specifically pure helium (He), pure deuterium (D_2), and 50/50 gas mixtures of D_2/He, on the pressure increase in an AEMF was investigated. As shown in Figure 2 - SI, minimal pressure increases were recorded in the presence of pure He and 50/50 gas mixtures of D_2/He, namely ≈1 Torr and 10 Torr, respectively. When pure D_2 was tested the pressure increased to 500 Torr within 2 minutes. These results indicate that, the decrease in pressure from D_2 to D_2/He mixtures and pure He is due to the presence of a gas that is not absorbed by the material (He). This agrees with the well-known “helium blanketing effect”, where helium can accumulate and prevent the LANA from absorbing hydrogen.

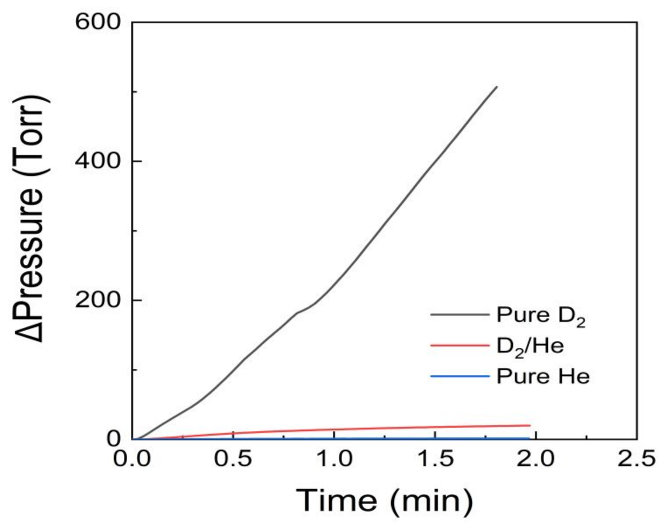

Figure 2 - SI. Effect of He in gas mixture on pressure increase for the m-LANA sample in a magnetic field (Power=80%, 27.3 G).

Pressure Composition Isotherm Calculations

The pressure composition isotherms were calculated using the ideal gas law and volumes that were measured using a helium volume calibration. The concentration of hydrogen was calculated:

$$[H_2]_{aliquot} = \frac{(P_{loaded} * V_{cal})/P_{after}}{RT}$$

Where P_{loaded} is the pressure of the calibrated volume before and after loading the hydrogen onto the LANA. This was measured using a pressure transducer before and after the valve was opened to the LANA material. The P_{after} was measured after the valve was closed and the pressure equilibrated after pressure and temperature fluctuations from the valve mechanism. R is the gas constant and T is the temperature, which was the temperature measured of the room. The concentration of hydrogen was then converted to moles of hydrogen and normalized to the moles of metal atoms in LANA.

Table 1. The rate of pressure increase vs. AEMF strength (6,23).

Power (%)	Current (Amps)	B (Tesla)	B (Gaussian)
50	6.4	$1.07x10^{-3}$	10.7
60	9.9	$1.66x10^{-3}$	16.6
70	13.3	$2.23x10^{-3}$	22.3
80	16.3	$2.73x10^{-3}$	27.3

Table 2. A compilation of ICP-MS results for LANA materials. The theoretical composition stoichiometry of $LaNi_{4.25}Al_{0.75}$ (LANA) is as follows: mol % - La=16.7%, Ni=70.8%, Al=12.5%.

Sample	Mol % La	Mol % Ni	Mol % Al
m-LANA	12.8	56.3	30.9
n-LANA	11.6	52.6	35.8

Table 3. Rate of pressure increase due to differences in the electromagnetic field strengths.

Power (%)	B (Gaussian)	Rate (Torr/min) of desorption for m-LANA-H_2
50	10.7	2.6
60	16.6	12.8
70	22.3	108.5
80	27.3	290.0

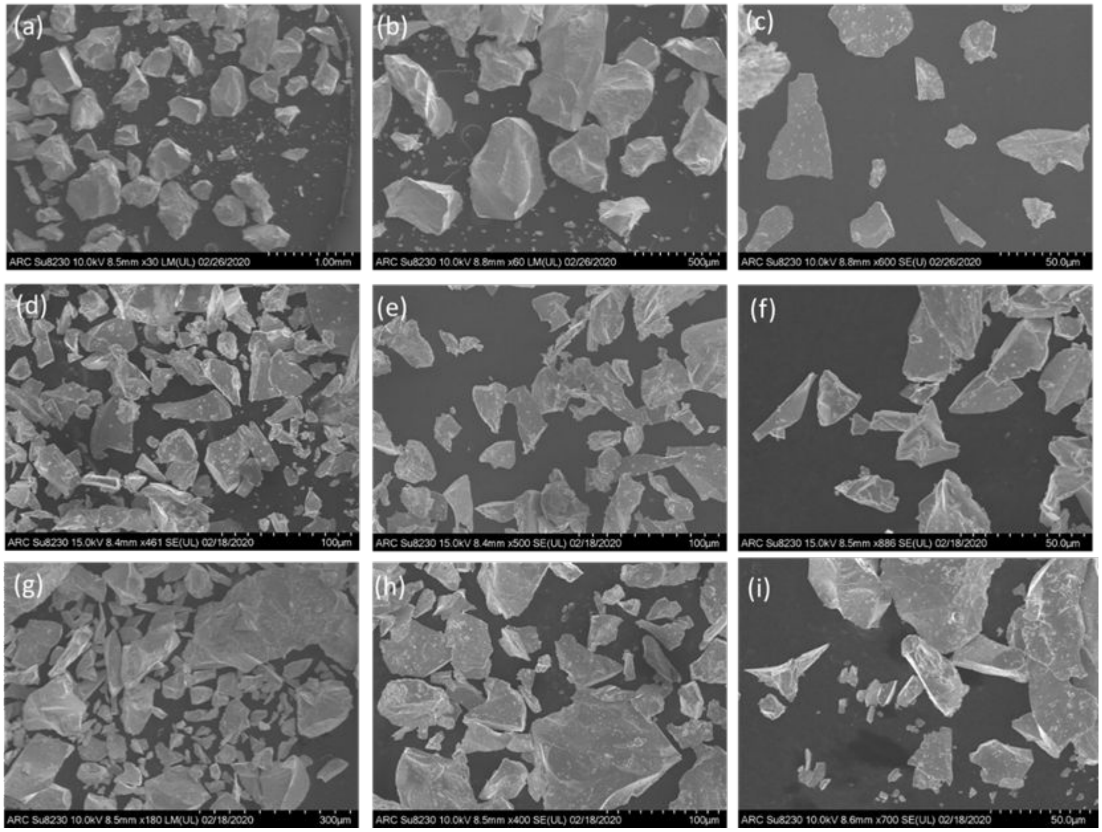

Figure 3-SI. SEM images of (a, b, c) a-LANA, (d, e, f) m-LANA and (g, h, i) n-LANA.