SNBL	**Experiment title:** Thermal dilatation measurements on hydrogen storage $LaNi_5$-type materials.	**Experiment number**: 01-02-294
Beamline: BM01A	**Date of experiment**: from: 6-march-01 to: 7-march-01	**Date of report**: 28-march-02
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$LaNi_5$ intermetallic and substituted compounds are known to absorb reversibly large amounts of hydrogen. They are commercially used for hydrogen gas storage or as electrodes in nickel-metal hydride (Ni-MH) batteries for portable devices. After hydrogen absorption-desorption cycling they generally show intense anisotropic powder diffraction line broadening. We have recently studied this broadening by X-ray powder diffraction at the SNBL (BM1B) [1, 2]. Anisotropic broadening could be interpreted in terms of dislocations whose nature and densities have been refined. Depending on the substitutions, a change of the dislocation system involved and extensive reduction of the dislocation density has been observed [2]. Resistance to hydrogen induced defects appears to be correlated with improved resistance to degradation by surface corrosion and decrepitation of the material, related to the cycle life. The key point for the differences in cycling behaviours observed in our materials seems to be their different elastic properties. Thus we have investigated these properties via compressibility [ESRF project CH-828 on ID-30] and thermal dilatation measurements.

Five samples with various substitution elements (Mn, Al, Co) have been studied in the temperature range 105 - 295 K, at fixed wavelength of 0.7007 Å. The powder samples were enclosed in a 0.3 mm glass capillary. The temperature was controlled by an Oxford Cryostream Cooler with the cool stream oriented perpendicularly to the capillary. The diffraction patterns were recorded with an MAR345 image plate at a distance of 120 mm.

The recorded images were transformed to 2-dimensional powder patterns by integration using the program FIT2D [3]. Diffraction patterns of satisfactory quality were refined by Rietveld refinement in order to obtain the lattice parameters *a* and *c* of the hexagonal lattice as a function of temperature at ambient pressure. Results for all the samples are summarized in Table 1. Figure 1. shows the relative variation of the lattice parameters for $LaNi_5$, $LaNi_{4.6}Mn_{0.4}$ and $LaNi_{3.55}Mn_{0.4}Al_{0.3}Co_{0.75}$. It can be seen that in none of the compounds studied the thermal dilatation is isotropic, the structure dilating more along *a* than along *c*. Moreover, the substitution leads to a significant softening of the lattice as shown by the increase of the volumic thermal expansion coefficients summarized in Table 1. The results are currently correlated with compressibility and low temperature heat capacity measurements [4].

Compound	Volumic thermal expansion coefficient β_V [10^{-5} K^{-1}]
$LaNi_5$	3.2
$LaNi_{4.7}Al_{0.3}$	3.4
$LaNi_{4.6}Mn_{0.4}$	3.6
$LaNi_{4.25}Co_{0.75}$	3.9
$LaNi_{3.55}Mn_{0.4}Al_{0.3}Co_{0.75}$	3.8

Table 1: Results of the thermal dilatation measurements.

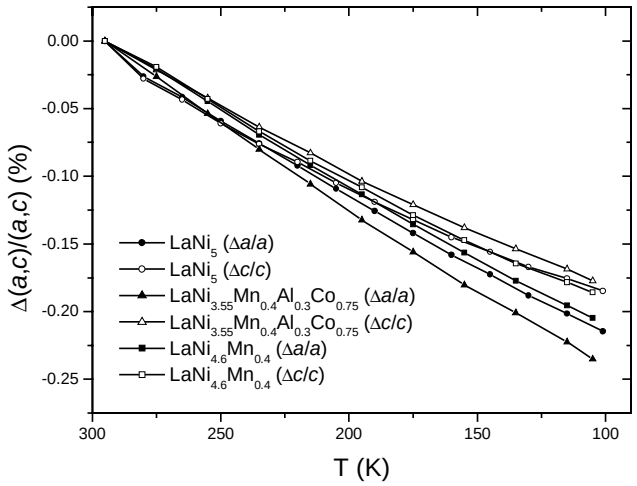

Figure 1: Lattice parameters *a* and *c* as a function of temerature for selected samples.

[1] Joubert J.-M., Černý R., Latroche M., Percheron-Guégan A. and Yvon K. *J. Alloys Comp.*, 265 (1-2) (1998) 311-314.

[2] Černý R., Joubert J.-M., Latroche M., Percheron-Guégan A. and Yvon K. J. *Appl. Crystallogr.*, 33 (2000) 997-1005.

[3] http://www.esrf.fr/computing/scientific/FIT2D

[4] Joubert J.-M., Latroche M., Černý R., Percheron-Guégan A. and Yvon K. to be published.