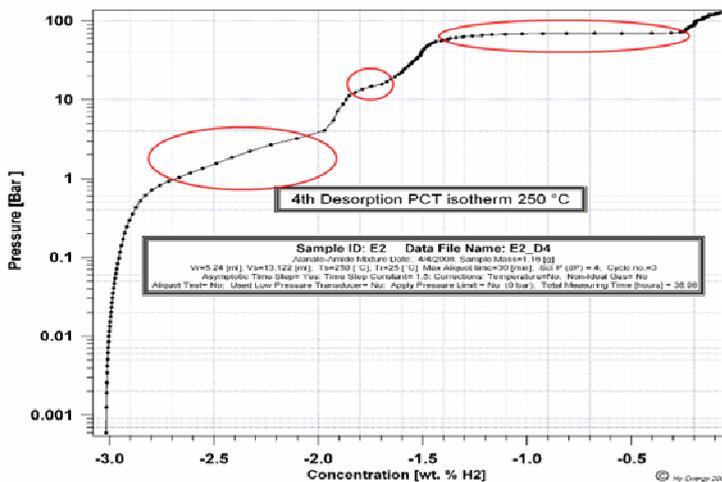


# Combined mass spectrometry and sorption measurements on mixed Alanate-Amide hydrogen storage materials

**Introduction:** There is a trend in hydrogen storage research towards investigation of complex systems with many components. These systems have multi-step reactions and, possibly, release gaseous species like ammonia, borane, etc. It is crucial to have a tool to follow and characterize the reactions process and products. The coupling of PCTPro 2000 with RGAPro (Reactive Gas Analysis) allows measurement of the gas sorption properties and simultaneously identification of the desorbed gas.



PCT measurement at 250 °C

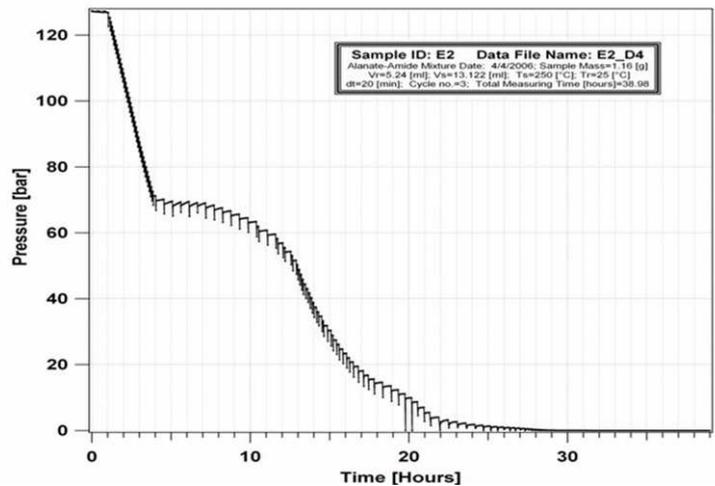
## Results of the PCT investigation

- The PCT isotherm demonstrates that the sorption process is a multi steps reaction with a wide range of thermodynamic stabilities.
- Each reaction is reversible and contributes to the total desorption kinetics.
- Kinetics of each reaction can be measured independently, thanks to the PCTPro-2000 time-resolved measuring capabilities.

## Experimental

The reaction of hydrogen with a alanate-amide mixture was characterized by:

- a PCT measurement to have a knowledge of the number of reactions involved in the process of sorption.
- a Temperature Programmed Desorption (TPD) measurement and the simultaneous analysis of the gas during the sorption.



PCT- kinetics data at 250 °C



## Instrument

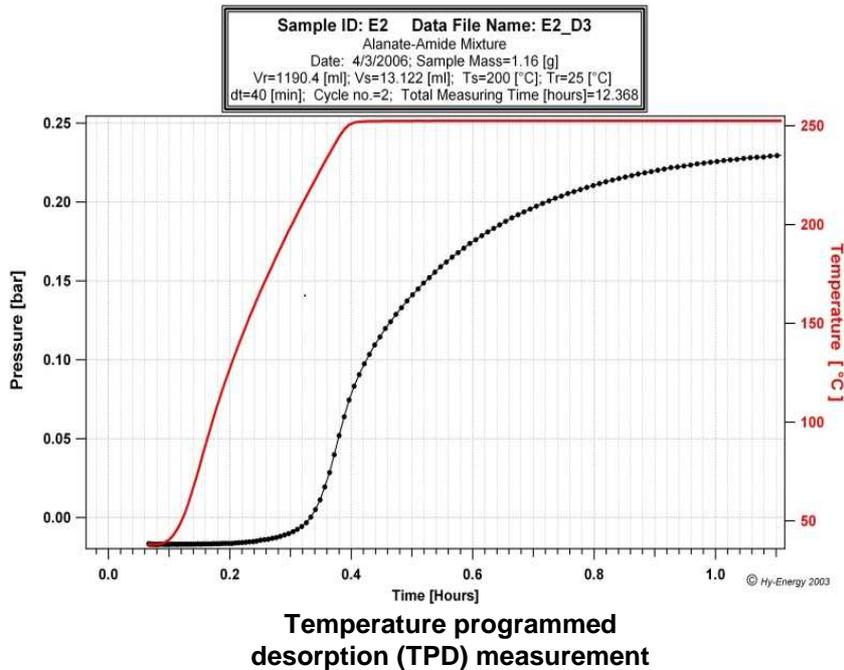
PCTPro-2000  
Gas sorption  
Sievert's  
apparatus  
-260 to 500°C

## Instrument

RGAPro  
Gas dosing mass  
spectrometer  
for vacuum to 200 bar

[www.setaram.com](http://www.setaram.com) – [sales@setaram.com](mailto:sales@setaram.com)



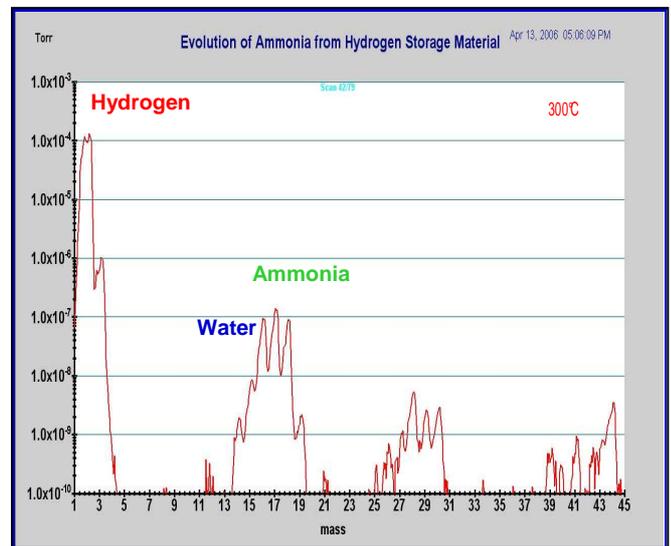


## Results of the TPD / RGA investigation

The samples temperature was increased steadily to 300°C and held at this temperature over a period of about 1 hour. Gas desorption began at about 200°C and the desorption rate increased with temperature. During the hydrogen desorption, the RGAPro was used to collect a series of mass spectra.

The in situ RGAPro measurements clearly demonstrate the desorption of hydrogen at about 200°C and the evolution of ammonia at temperatures approaching 300°.

This information is of critical importance for use of such hydrogen storage materials with PEM Hydrogen Fuel Cells, as it clearly establishes that ammonia is present as a decomposition contaminant that may damage the fuel cell's catalysts. In addition, these measurements provide a fundamental insight into the decomposition process and reduced cycling capacities of this class of materials.



Mass spectra scan at 300 °C during the TPD

## Conclusion

The PCTPro-2000 / RGAPro combination provides a powerful analytical tool to fully characterize complex gas sorption reaction processes. Simultaneous gas sorption combined with gas composition analysis is a very valuable tool for a wide range of materials research and development.