

## Experiment Report Form

**The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.**

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

*<http://193.49.43.2:8080/smis/servlet/UserUtils?start>*

### ***Reports supporting requests for additional beam time***

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

### ***Reports on experiments relating to long term projects***

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

### ***Published papers***

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.


### **Deadlines for submission of Experimental Reports**

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

### **Instructions for preparing your Report**

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.



	<b>Experiment title:</b> Characterisation of Pt active sites for propane dehydrogenation	<b>Experiment number:</b> CH-2863	
	<b>Beamline:</b> ID26	<b>Date of experiment:</b> from: 13/05/2009 to: 19/05/2009	<b>Date of report:</b> 8/4/2010  <i>Received at ESRF:</i>
	<b>Shifts:</b> 18	<b>Local contact(s):</b> Tsu-Chien Weng	
<b>Names and affiliations of applicants</b> (* indicates experimentalists):  Dr. A. Iglesias-Juez, Dr A. M. Beale (University of Utrecht)*  Prof. F.M.F. de Groot (University of Utrecht)  Dr. P. Glatzel (ESRF)			

## Report:

The object of this study was to understand further both the nature of the catalytically active phase for propane dehydrogenation and the mechanism/processes by which the catalysts undergo both an initial activation and permanent deactivation. Two catalysts were examined: Pt and Pt-Sn samples supported on alumina ( $\gamma\text{-Al}_2\text{O}_3$ ). The metal loading on these types of catalyst was low (0.5 wt Pt/Sn %) thus XANES and EXAFS at the Pt  $L_{III}$  edge in fluorescence mode was recorded in order to analyse particle size/shape, the extent of alloy formation and thus the electronic modifications during the catalytic reaction (propane to propene and hydrogen). For this catalytic study, the ESRF environmental fluorescence cell was used with the gas outlet connected to a mass spectrometer in order to follow the activity. In figure 1, we show the results from the pre-reduction of the Pt-Sn sample as a function of temperature. The figure demonstrates the structural evolution for the bimetallic Pt-Sn catalyst via the following steps: reduction of  $\text{Pt}^{2+}$  to  $\text{Pt}^0$  and the eventual formation of Pt-Sn bimetallic clusters. The catalyst was then studied in situ, during propane dehydrogenation. We were able to observe the following changes during reaction: the interaction of gaseous species with the Pt catalyst particles, permanent deactivation of the catalyst during regeneration by formation of larger bimetallic clusters, an evolution of the bimetallic structure from inhomogeneous to homogeneous species. For comparison, the same protocol was used to compare the behaviour of Pt-Sn- $\text{Al}_2\text{O}_3$  with the simple Pt- $\text{Al}_2\text{O}_3$  and clear differences between the two catalysts were observed.

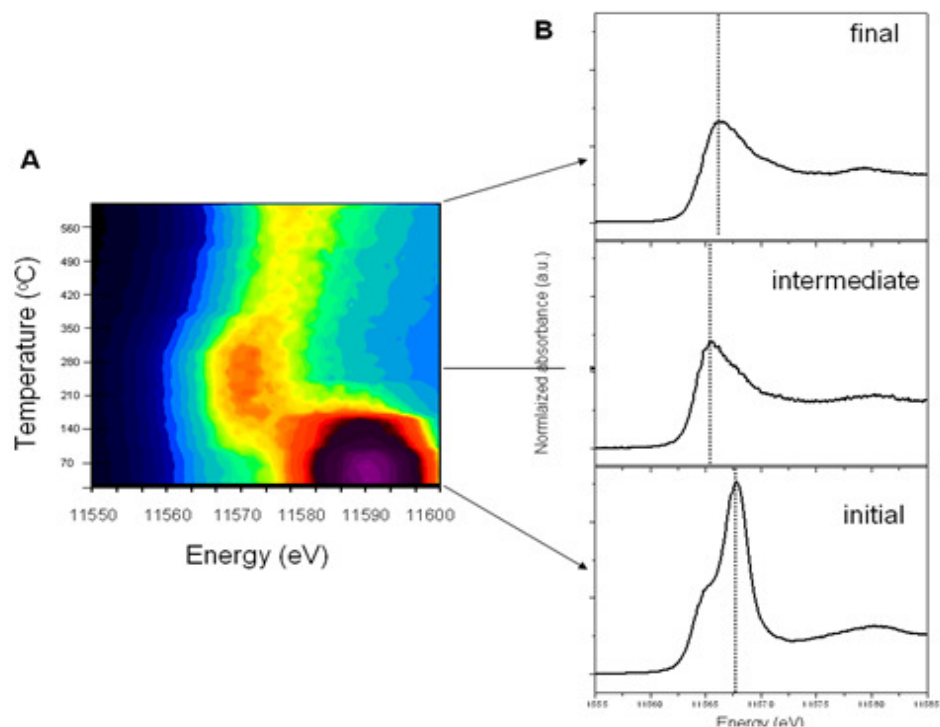


Figure 1. A contains a contour plot of the Pt L<sub>III</sub> XANES data for the Pt-Sn-Al<sub>2</sub>O<sub>3</sub> sample as a function of temperature whilst heating in a flow of hydrogen. B contains few select spectra at various times during hydrogen treatment, detailing both a change in the position and intensity of the rising absorption edge. These changes can be interpreted in terms of the reduction of Pt<sup>2+</sup> to Pt<sup>0</sup> and the eventual formation of Pt-Sn bimetallic clusters.