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| ESRF | **Experiment title: XAFS studies on the effect of support and pretreatmant on the state of Pt and Sn in Pt-Sn catalysts** | **Experiment number**: CH-1101 |
| **Beamline**: BM01b | **Date of experiment**: from: 6 February 2002 to: 12 February 2002 | **Date of report**: 14 February 2002 |
| **Shifts:** 15 | **Local contact(s)**: Hermann Emerich | *Received at ESRF:* |

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## Report:

Platinum exhibits high activity for C-H bond rupture coupled with a poor ability to cleave C-C bonds. The metal is therefore a key component in most dehydrogenation catalysts. The stability of the catalyst is increased and its deactivation rate decreased if tin is added. This enhancement of the selectivity is due to the inhibition of the formation of dehydrogenated species.

We have used the XAFS facilities of the Swiss-Norwegian beamline to study the local structures about the tin and platinum atoms in a series of formulations of the catalyst. This also involved different support materials (Mg(Al)O, $Al_2O_3$, MgO). A total of ten samples (including different stages of treatment) were measured at the Sn K-edge (29.200 keV) and Pt $L_{III}$-edge (11.564 keV).

To avoid oxidation, the reduced samples and the samples used for propane dehydrogenation were presealed under He in 3mm quartz capilleries (0.01mm wall thickness). These were compared with the unreduced samples and the model compounds. References and models were the metal foils, $PtO_2$, SnO and $SnO_2$.

Since the metal loadings are relatively low data were measured in fluorescence mode. The initial measurements were carried out using a borrowed photodiode detector from the ESRF pool. However, it immediately became apparent that this detector could not measure up to the accepted spectral standard. We therefore dug out our mothballed Lytle detector and borrowed a fluorescence filter for tin (In 6 absorption lengths) we had already the filter for Pt (Ga 3 absorption lengths). This detector functioned to our satisfaction giving dramatically improved spectra (only the single scans are shown below).

**Measurements at the tin edge**

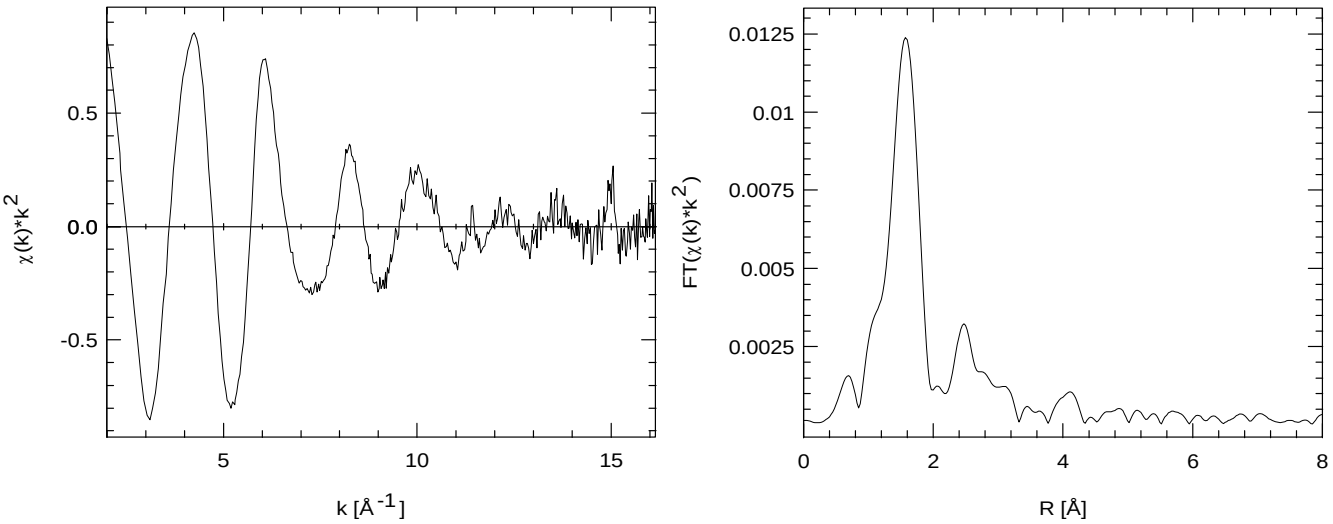


**Figure 1:** The Sn EXAFS and its Fourier transform from a single XAS scan of 0.25%Pt-1.25%Sn/Mg(Al)O used in propane dehydrogenation (not exposed to air).

Although the data are currently being processed, several qualitative features are already apparent from the spectrum in Figure 1 and the other spectra: A major fraction of the Sn atoms are not competely reduced. The different supports also influence the physical and chemical nature of the metal particles.

**Measurements at the platinum edge**

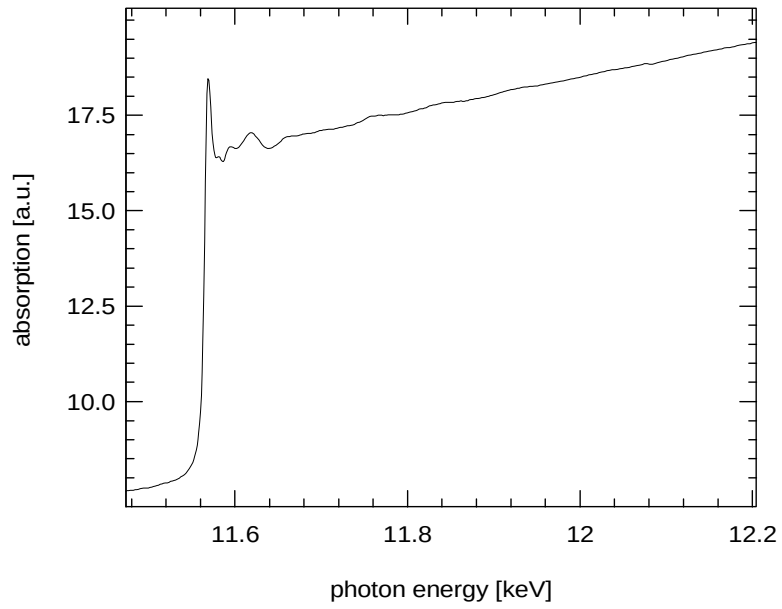


**Figure 2:** The Pt $L_{III}$ XAS profile (single scan) of 0.25%Pt-1.25%Sn/Mg(Al)O used in propane dehydrogenation (not exposed to air).

The EXAFS at the Pt –edge gives us information on particle size and composition. The data are currently being correlated with other physiochemical data.