

**Experiment title:**

Tracking yttrium superhydrides with valence-to-core XES

Experiment number:

HC-4710

Beamline:

ID20

Date of experiment:

from: 18 Jan 2022

to: 24 Jan 2022

Date of report:

03.03.2022

Shifts:

15

Local contact(s):

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Report:

In this very successful beamtime HC-4710 at beamline ID20 we measured valence-to-core X-ray emission spectra (vtc XES) of yttrium compounds at high pressure from inside the diamond anvil cell (DAC), with the new in-vacuum von-Hámos spectrometer at ID20. Among the yttrium compounds – which we measured up to 130 GPa – were yttrium superhydrides that have recently been reported to be very high T_c superconductors. Their in-situ characterization is difficult with many techniques, because the hydrogen is such a weak X-ray scatterer. This calls for the validation of novel measurement techniques.

Valence-to-core X-ray emission spectroscopy is a promising technique for the investigation of superhydrides, because the binding energy of the hydrogen 1s electron is reflected in the spectra. See Figure 1 for a comparison of predicted spectra (top) and measured spectra (bottom).

At the same time, this was the first beamtime to combine the new ID20 von-Hámos spectrometer with in-situ measurements from inside a diamond anvil cell. Most successful, thanks to the unrivaled expertise of beamline staff, focus size on sample and stability of the beamline.

Unfortunately, we could not yet reach those pressures above 150 GPa needed for a fully convincing complete dataset. For this reason, we will again apply for beamtime of this state-of-the-art experiment.

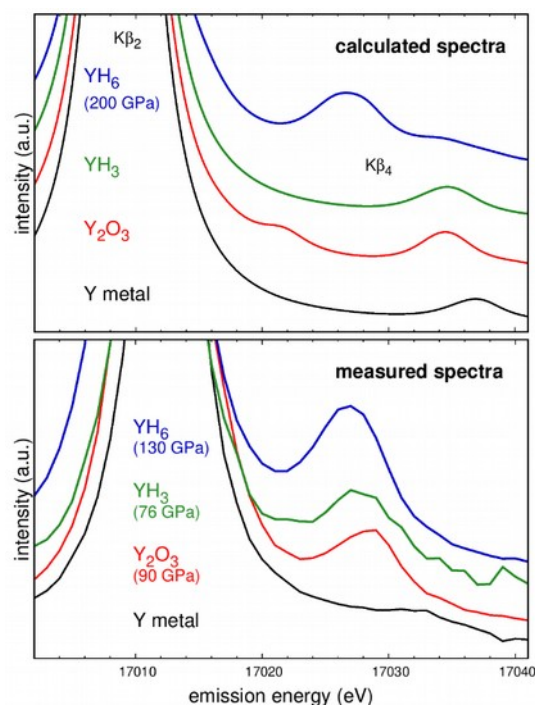


Figure 1: Valence-to-core XES spectra of yttrium compounds at high pressure. Note shift and intensity change of the $K\beta_4$ emission line.