

Experiment 08-01-1061, BM08

Title: Local structure of Fe thin films after high temperature thermal processes

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Experimental conditions: XAS at Fe K-edge at 80 K.

Samples:

The samples are SiO₂-capped Fe films deposited on silica slides. In this experiment we measured the Fe K-edge XAS spectra of the films after the high-temperature (up to 1100C) thermal processes in vacuum carried out during the experiment HC-3491 (ID26).

Report

In the ID26 experiment we monitored in-situ, during annealing in vacuum, the bcc-fcc phase transition of Fe in thin films of different thickness. We showed that this martensitic phase transition is inhibited for thickness below about 100 nm. The experiment of the present report was planned to measure the local order around Fe (XANES and EXAFS) after those treatments.

We measured the Fe K-edge XAS spectra of all the films (thickness from 10 nm to 250 nm, i.e. including both films where the phase transition was seen, and those where the transition was inhibited).

The XAS spectra were measured in fluorescence mode by a 12 elements HP Ge detector, at 80 K to limit atomic vibrations. Data quality was pretty nice in all cases.

The analysis is still ongoing. Essentially, the EXAFS analysis is finished, while the interpretation of XANES spectra is still running.

There are two main points that come out from the experiment.

- 1) The EXAFS spectra are all compatible with Fe bcc phase. As expected, no important changes are found between samples. As an example, the picture on the left shows two EXAFS spectra: the one in blue is recorded for the as-deposited fcc film. The one in red is the same film after annealing.

- 2) For all the films where the bcc-fcc phase transition was inhibited, a small change in the XANES spectra was recorded. In particular, a shoulder at 7125 eV rises, while the shoulder at about 7115 eV does not change (i.e., no oxidation). As an example, in the figure on the right the blue XANES spectrum is recorded for a 100-nm thick as-deposited Fe film, while the red one is the same sample after annealing.

