Experiment Report Form

The double page inside this form is to be filled in for each experiment at the Rossendorf Beamline (ROBL). This double-page report will be reduced to a one page, A4 format, to be published in the Bi-Annual Report of the beamline. The report may also be published on the Web-pages of the FZD. If necessary, you may ask for an appropriate delay between report submission and publication.

Should you wish to make more general comments on the experiment, enclose these on a separate sheet, and send both the Report and comments to the ROBL team.

Published papers

All users must give proper credit to ROBL staff members and the ESRF facilities used for achieving the results being published. Further, users are obliged to send to ROBL the complete reference and abstract of papers published in peer-reviewed media.

Deadlines for submission of Experimental Report

Reports shall be submitted not later than 6 month after the experiment.

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 / experiment 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.
- bear in mind that the double-page report will be reduced to 71% of its original size, A4 format. A type-face such as ”Times” or ”Arial” , 14 points, with a 1.5 line spacing between lines for the text produces a report which can be read easily.

Note that requests for further beam time must always be accompanied by a report on previous measurements.

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ROBL-CRG	**Experiment title:** Fundametal studies on immobilization of long-lived radionuclides after incorporation into apatites	**Experiment number**: 20-01-735
Beamline: BM 20	**Date of experiment**: from: 12.11.2013 to: 16.11.2013	**Date of report**: 29.04.2014
Shifts: 4	**Local contact(s)**: Dr. Janeth Lozano	*Received at ROBL:* Dr. A. Scheinost, Dr. J. Lozano, Dr. A. Rossberg, Dr. C. Hennig, Dr. R. Butzbach

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Report:

The aim of the project was to synthesize, by coprecipitation method from aqueous solution, the apatite and layered double hydroxide (LDH) matrices for the immobilization of radioactive iodine (^{129}I). Iodine-129 being a long-lived volatile fission product which represents a pareticular challenge for the design of repository suited matrices. However, all matrices were synthesized using a stable iodine isotope (^{127}I).

The EXAFS data of iodate incorporated into apatite showed I – O bond distance of *ca.* 1.8 Å (Figure 1), while longer distance interactions are not present as is the case for solid potassium iodate reference. The EXAFS data of iodide incorporated into apatite showed no short range interactions, whereas iodide adsorbed on the crystalline apatite repeats the distances present in the solid potassium iodide reference, but with

lower amplitude. Therefore, two different mechanisms of iodate or iodide interaction with apatite are revealed, incorporation into crystal structure and surface adsorption.

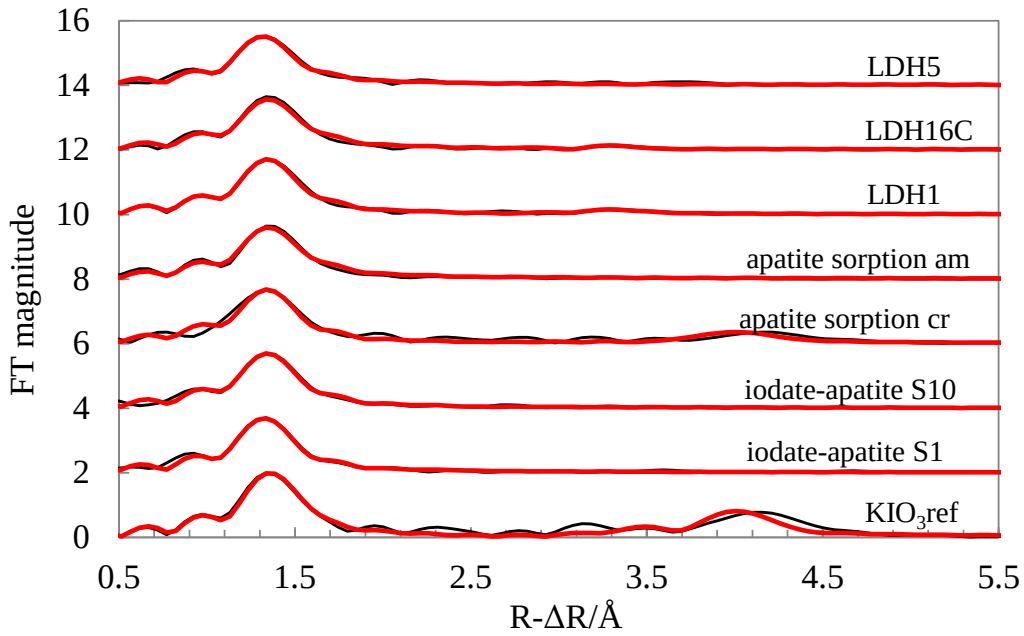

Figure 1. Fourier transform (FT) of the apatite and LDH with incorporated iodate.

Two manuscripts which will present collected EXAFS data “Iodate and iodide incorporation into layered double hydroxides of different composition” and “Immobilization of iodine into apatite matrix: physical-chemical properties and iodine K-edge EXAFS” are in preparation.

The iodate-hydroxyapatite with *ca*. 5 – 7 wt. % of iodine has been synthesized by coprecipitation from alkaline aqueous solution. The iodide does not incorporate into hydroxyapatite. The iodate release from the apatite starts at heating > 500 °C, whereas LHD release > 80% of iodine already at t ≈ 180 ºC and more than 90 % is leached by MilliQ water after one month. 40 % of iodate leached from LDH only after one day in brine (0.1 M Na_2SO_4 and 1 M $MgCl_2$) solution. Therefore, apatite is a suitable matrix for immobilization of radioactive iodine for a long-term storage, whereas LDH might be used for a short-term storage only.