EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

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 via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can 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.

ESRF	**Experiment title:** Evaluating osseointegration of dental implants on micrometer scale by micro-CT	**Experiment number**: MD-745
Beamline: ID19	**Date of experiment**: from: April 12th to: April 16th	**Date of report**:
Shifts: 12	**Local contact(s)**: Alexander Rack	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

*Mikkel Schou Nielsen, PhD student, MSc, The Niels Bohr Institute, University of Copenhagen, Denmark

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Else Marie Pinholt, DDS, M Sci, dr.odont, Professor and Head, Department of Oral and Maxillofacial surgery, Institute of Odontology, Faculty of Health Sciences, University of Copenhagen, Copenhagen, Denmark

Robert Feidenhans'l, Professor ,Dr., The Niels Bohr Institute, University of Copenhagen, Denmark

Report:

A) Overview

The aim of the beam time was to perform high resolution phase-contrast tomography scans with 1.8um effective pixel size of 35 bone samples which contained dental titanium implants.

Earlier synchrotron absorption tomography scans (5um effective pixel size) had demonstrated the great potential of investigating the bone-to-implant contact and bone density. These scans did not provide adequate information of the bone structure in close proximity to the implant due to artefacts. Using phase-contrast, we hoped to gain even better contrast between implant, existing bone and bone structure.

B) Quality of measurement/data

The measurement time for each tomogram was 15 min giving a scan time per sample of 45 min which was faster than anticipated. However, we only obtained approximately half of the scans due to four beam-dump events during the beam time.

Preliminary results, as seen from figure 1, indicate a noticeable improvement in resolution and contrast of these scans compared with previous data. The interface between the titanium implant and bone/cavities was noticeably enhanced, with fewer artefacts at the surface.

C) Status and progression of evaluation

The pre-processing of data was nearly carried out at the beam line during our beam time. The remaining pre-processing was carried out later and mailed to us. The huge amount of data acquired (> 5 Tb) has resulted in a long waiting time while data is being transferred to the local server at the Niels Bohr Institute. Hence, further data analysis and evaluation has not been started yet.

D) Results

From the preliminary results, it appears that the increased spatial resolution will enable a better determination of the bone-to-implant contact and through the phase-contrast modality we expect the bone density calculations to be performed.

The determination of the bone-to-implant contact and the bone density calculations will give us new knowledge about the osseointegration of dental implants in reconstructed- and in recipient bone.

Figure 1: The initially reconstructed 1.8 µm scan using phase contrast, where the bone-to-implant interface is more accurate than on the 5 µm scans.