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 using the **Electronic Report Submission Application:**

*http://193.49.43.2:8080/smis/servlet/UserUtils?start*

***Reports supporting requests for additional beam time***

Reports can now 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: TC spatially resolved plastic deformation in highspeed machining of carbon steel (C45E (old CK45)).** | **Experiment number**: TC-128 |
|---|---|---|
| **Beamline**: ID13 | **Date of experiment**: from: 16.02.2002 7h to: 16.02.2002 23h | **Date of report**: 27.02.2002 |
| **Shifts:** 1 | **Local contact(s)**: Dr. S. V. Roth | *Received at ESRF:* |


**Names and affiliations of applicants** (* indicates experimentalists):

**Prof. K. Maier (ISKP- University of Bonn Germany)**

Dr. Stephan Roth (Local contact)
Dr. Torsten Staab (ISKP- University of Bonn Germany)
Ingo Müller (ISKP- University of Bonn Germany)*
Matz Haaks (ISKP- University of Bonn Germany)


**Preliminary report:**
**This Experiment was a first test of the potential of detecting local plastic deformation in highspeed machining of a carbon steel C45E employing x-ray diffraction. Two sample were analysed during this test.**

**Sample 1:**

**Not deformed C45 sample: Thinned down to 70 μm by mechanical polishing and then thinned in the center of the sample down to 50 μm using chemical polishing. It was only used for testing the sample preparation of the experimental setup. The images are not analysed yet.**

**Sample 2:**

**C45 sample deformed by highspeed machining of the sample (see fig. 1). After machining the sample was thinned to 80μm by mechanical polishing and the center of the sample was thinned down to 40 μm using chemical polishing. Measurements with positron annihilation shows that the sample preparation has a negligible influence on the measurement.**

**Used settings:**

**wavelength: λ=0,9755Å / energy: E=12.71keV / collimator: ∅=10μm**

**The broadening of the Iron [211]-reflex was analysed at different locations on the probe.**

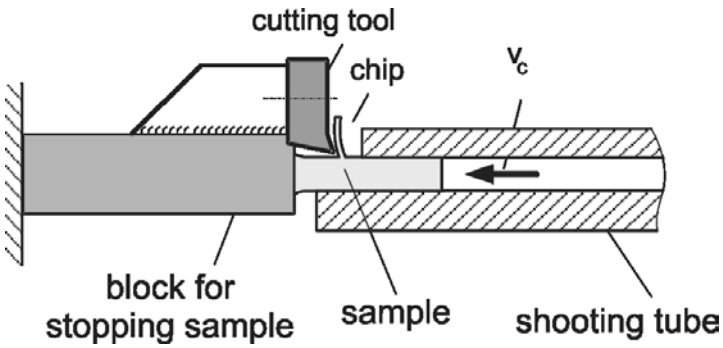


*Fig. 1: For simulation of highspeed machining the sample is shot towards a cutting tool which is mounted on a stopping block*

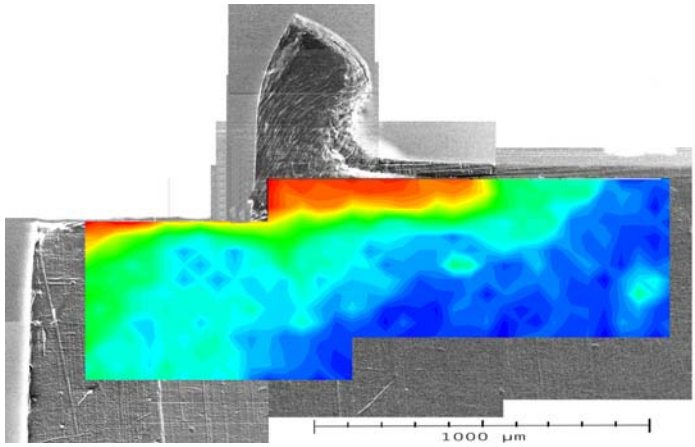


*Fig. 2: SEM-Image of a chip. The coloured map on top shows the variation in the defects density measured by the Bonn-Positron-Microprobe.(dark blue= few defects, red: defect rich)*

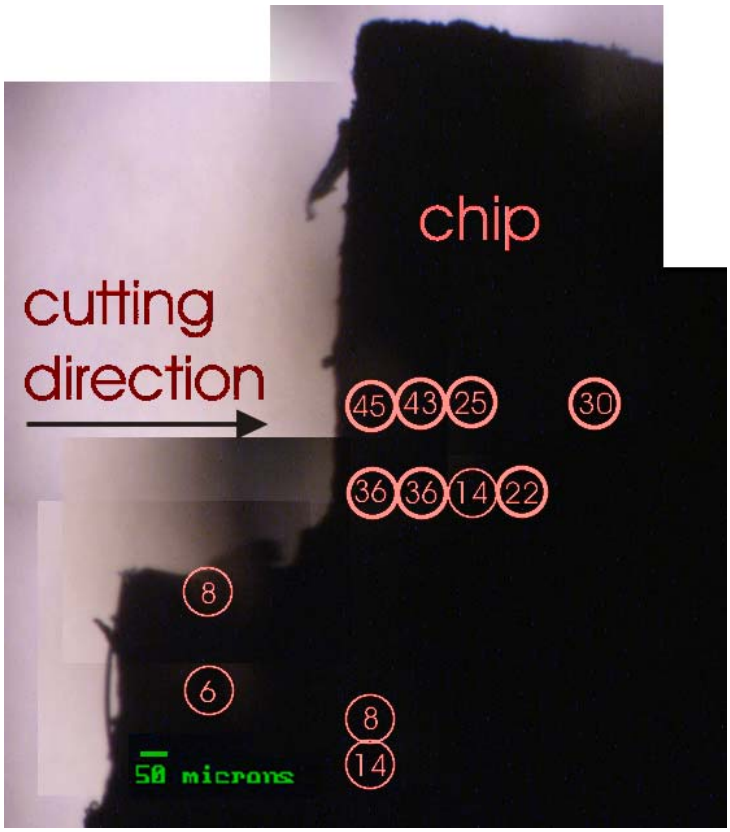


*Fig. 3: Measurement of the internal stress distribution in sample 2. The dark image is a photo of the sample and the circles indicate the locations where the line broadening was measured. The number inside each circle is the FWHM of the Iron[211] reflex (in units of pixels with a error of 5 five pixels).*

**This first test clearly shows that it is possible to detect the internal stress in the ferritic steel C45 after highspeed machining spatially resolved by x-ray diffraction.**
**Since X-Ray diffraction is sensitive to a variation of the lattice constant due to dislocations, while positrons (see Fig.2) probe point defects and dislocations, these two methods are complementary to each other.**