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:** Determination of the dynamics of topochemically driven solid-state reactions	**Experiment number**: CH-1227
Beamline:	**Date of experiment**: from: 28/03/02 to: 02/04/02	**Date of report**: 20/02/03
Shifts:	**Local contact(s)**: A. Plech, M. Wulff	*Received at ESRF:*

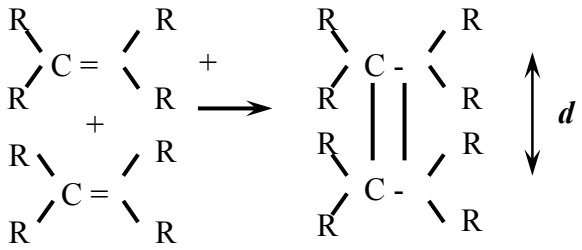
Names and affiliations of applicants (* indicates experimentalists):

*Techert, Simone, Linda Woo, MPIbpcC, Dep. 010, 37077 Goettingen, Germany

* Tschentscher, Thomas, HASYLAB at DESY Notkestr. 85, D-22603 HAMBURG, Germany

Report:

In experiment No CH1227 we have investigated the light-induced topochemical reaction of t-cinnamic acid according to the scheme



As pump pulses 267 nm light was chosen (150 fs pulse width), the wavelength of the x-ray probe pulse was 0.753 A (80 ps pulse width). A technical greatly improved beamline ID09B made it possible to expose the sample in less than 10 minutes and to repeat timescans x-times on various samples in order to improve the statistics of the experiment.

Measuring the transient x-ray signal changes as a function of time resulted in the correlation functions as shown in Fig.1.

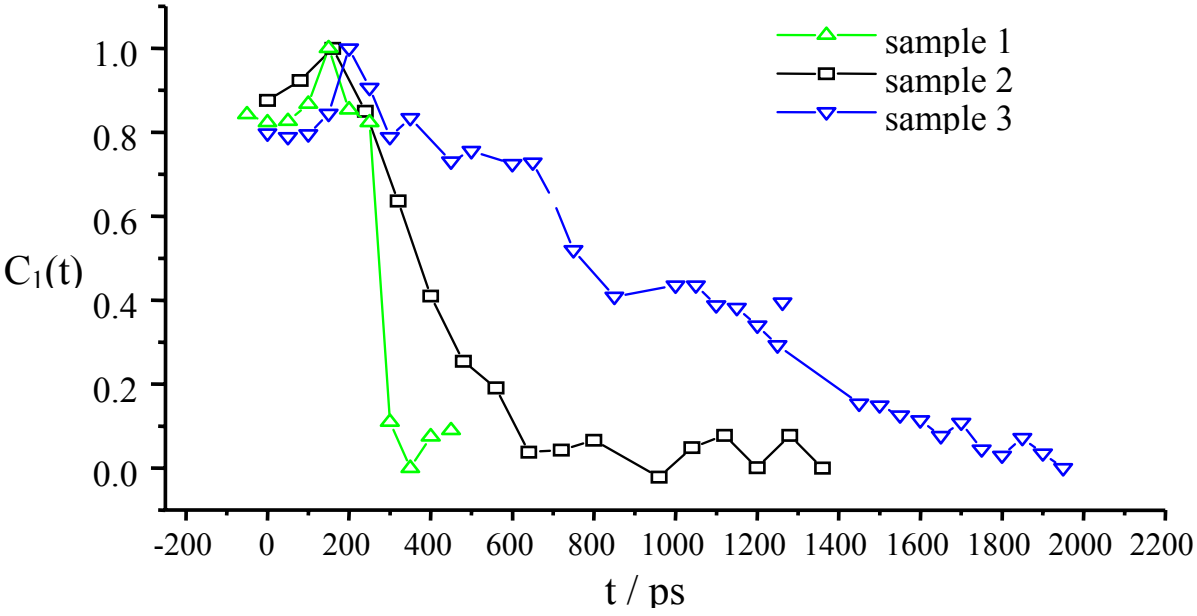


FIG. 1: Fast time behaviour of the correlation function $\widetilde{C}_1(t)$ of the most prominent Bragg diffraction peak (peak No. 4) for three representative samples. Note that the scaled correlation function $\widetilde{C}_1(t)$ = *a* C_1 *(t)* with *a*(sample1) = 0.875, *a*(sample2) = 1.285 and *a*(sample3) = 1.402 is shown for clarity.

The transient changes of this topochemical reaction are assigned to disorder processes on the time course of photo-dimerisation to the amorphous product state (Fig. 2).

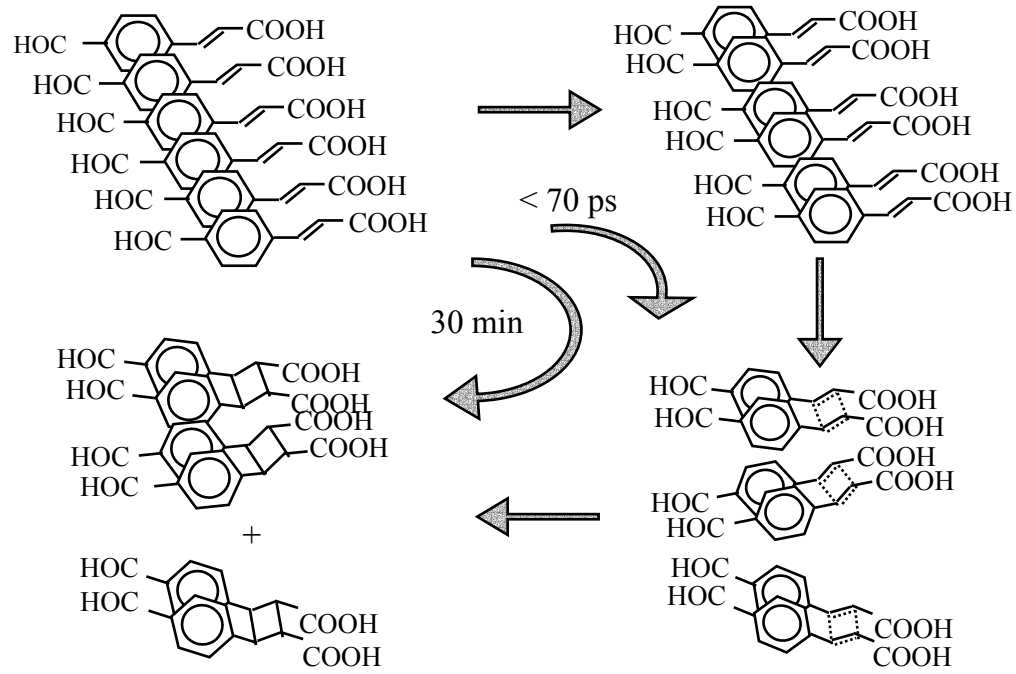


Figure 2: The picosecond increase of the FWHM can be interpreted as a light-induced phonon motion, which – as some kind of Peierls distortion – forms a pair-like metastable crystal state. Coinciding with this – small - distortion of the lattice a transient pair-like state is formed guiding the reaction to the product dimer. Since the lattice deformations are so strong during the product formation, with progressing crystal transformation it splits into smaller domains (and peaces) leading to a complete amorphisation after 30 min.

Further details concerning the experiment and results can be found in G. Busse, Th. Tschentscher, A. Plech, M. Wulff, B. Frederichs and S. Techert, *Faraday Discuss.* **122**, 105 ff (2002 / 2003).