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:** Watching a DNA Origami Device Switch by Time-Resolved SAXS	**Experiment number**: LS-2649
Beamline: ID02	**Date of experiment**: from: 3.3.2017 to: 6.3.2017	**Date of report**: 05-04-2018
Shifts: 9	**Local contact(s)**: Theyencheri Narayanan	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Prof. Dr. Jan Lipfert, LMU Munich, Chair of Biophysics and Applied Materials

Dr. Linda Brützel*, LMU Munich, Chair of Biophysics and Applied Materials

M.Sc. Philipp Walker*, LMU Munich, Chair of Biophysics and Applied Materials

Report:

The beamtime allocated to proposal LS-2649 was used to perform time-resolved solution SAXS measurements on a DNA origami switch device.

Self-assembled DNA structures enable creation of specific shapes at the nanometer−micrometer scale with molecular resolution. The construction of functional DNA assemblies will likely require dynamic structures that can undergo controllable conformational changes. DNA devices based on shape complementary stacking interactions have been demonstrated to undergo reversible conformational changes triggered by changes in ionic environment or temperature. An experimentally unexplored aspect is how quickly conformational transitions of large synthetic DNA origami structures can actually occur. Here, we use time-resolved small-angle X-ray scattering to monitor large-scale conformational transitions of a two-state DNA origami switch in free solution. We show that the DNA device switches from its open to its closed conformation upon addition of $MgCl_2$ in milliseconds, which is close to the theoretical diffusive speed limit. In contrast, measurements of the dimerization of DNA origami bricks reveal much slower and concentration-dependent assembly kinetics. DNA brick dimerization occurs on a time scale of minutes to hours suggesting that the kinetics depend on local concentration and molecular alignment.

The work was recently published [1]:

[1] L. K. Bruetzel, P. U. Walker, T. Gerling, H. Dietz, and J. Lipfert, “Time-Resolved Small-Angle X-ray Scattering Reveals Millisecond Transitions of a DNA Origami Switch,” *Nano Lett.*, p. acs.nanolett.8b00592, Mar. 2018.