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

Deadlines for submission of Experimental Reports

Experimental reports must be submitted within the period of 3 months after the end of the experiment.

Experiment Report supporting a new proposal ("relevant report")

If you are submitting a proposal for a new project, or to continue a project for which you have previously been allocated beam time, you must submit a report on each of your previous measurement(s):

- even on those carried out close to the proposal submission deadline (it can be a *"preliminary report"),*
- even for experiments whose scientific area is different form the scientific area of the new proposal,
- carried out on CRG beamlines.

You must then register the report(s) as "relevant report(s)" in the new application form for beam time.

Deadlines for submitting a report supporting a new proposal

- 1st March Proposal Round - **5th March**
- 10th September Proposal Round - **13th September**

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.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report in English.
- include the experiment number 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:** Measuring the alignment and breakdown of worm-like micelles at ultra-high shear rates	**Experiment number**: SC-5174
Beamline:	**Date of experiment**: from: 19 Nov 2021 to: 22 Nov 2021	**Date of report**:
Shifts:	**Local contact(s)**: William Chevremont	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

MURPHY, Ryan P. [1]*; SALIPANTE, Paul F. [1]; BEAUCAGE, Peter A. [1]*; MARTIN, Tyler B. [1]*; KELLEY, Elizabeth G. [1]*; WEIGANDT, Katie M. [1]*; HUDSON, Steven D. [1]*; CHÈVREMONT, William [2]*; NARAYANAN, Theyencheri [2]*

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[2] European Synchrotron Radiation Facility, Grenoble, France

Report:

Processing methods such as spraying, coating, and jetting can produce extreme flow velocities within confined geometries. High shear rates and stresses near the wall can induce reversible or irreversible changes within the complex fluid microstructure. To quantify these flow-induced changes, a capillary rheometer was developed to measure the viscosity of complex fluids at high shear rates and to measure the microstructure simultaneously using small-angle scattering. Originally developed for small-angle neutron scattering [1], the same capillary setup and methodology was expanded recently for x-ray scattering and measured at the ESRF ID02 USAXS beamline [2], which enables significantly lower count times per shear rate, improved sample and shear rate throughput, higher shear rates up to 10,000,000 s^-1, and extremely confined flows within capillaries down to 500 nm. The ESRF measurements have led to significant improvements in the rheometer design criteria, validation of fluid structure measurements in surprisingly small capillary inner diameters, and software control improvements to better integrate triggered data acquisition procedures to take full advantage of high-flux x-ray sources. The structure-rheology relationships of different complex fluids were measured and analyzed, including branched and unbranched worm-like micelles, surfactant tubules, silica nanoparticles, and larger colloidal crystals. By combining and expanding the measurement capabilities of capillary rheometry and small-angle scattering methods, new fundamental insights can be used to produce pharmaceuticals, coatings, lubricants, and fuel additives with improved flow-stability and rheological behavior. This work was presented at two international conferences [2], and the first publication showcasing these ESRF measurements is in preparation to be submitted to the *Journal of Rheology* in fall of 2023 [3].

References:

[1] R. P. Murphy, et al., Soft Matter. 16, 6285-6293 (2020).

[2] R. P. Murphy, et al., Results presented at the SAS2022 conference in Campinas, Brazil (2022) and at the International Congress on Rheology in Athens, Greece (2023).
[3] R. P. Murphy, et al., First publication in preparation for Journal of Rheology (2023 in prep.)