The microfluidic laboratory at the Synchrotron SOLEIL

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1. Introduction

Synchrotrons offer a wide range of photon-based techniques, which outcompete tabletop instruments that can be found in a laboratory. These techniques are as varied as spectroscopy, diffraction, diffusion or imaging, using photons ranging from the IR to Hard X-rays, through UV and soft X-rays. A microfluidic laboratory has recently opened at SOLEIL, the French national synchrotron source, with the aim to combine advanced photon techniques with microfluidic tools. Applications in protein crystallography, physico-chemistry of interfaces and nanoparticles synthesis are expected on the short term.

2. Laboratory description and upcoming projects

The microfluidic laboratory of SOLEIL aims at providing the environment, the tools and the expertise for users to develop original research projects that combine synchrotron-based techniques and microfluidics. A 25m^2 clean room and a 20m^2 shop is available for users. The cleanroom features all the equipment required for the preparation of microfluidic chips by soft lithography (spincoater, insulating device, laserwriter, profilometer), while the shop has a 3D-printer, pressure controller and microscopes for device testing.
We are currently working on the three following projects:

i) The development of microfluidic traps for the immobilization of micron-sized protein crystals and their subsequent study by X-ray diffraction. This method allows studying protein crystals at room temperature and under "friendly" conditions as compared to cryogenic conditions. This project is led by Leonard Chavas from the Proxima-1 beamline.

ii) Microfluidic mixers are being developed for the time-resolved study of protein folding processes and nanoparticle synthesis using small angle X-ray scattering (SAXS). This work is carried out by the team of the SWING beamline.

iii) Microfluidic electrochemical cells are also being developed, with the final aim of performing sequential CO_2 reduction reaction. Along the course of this multi-step reaction, we will probe the structural and electronic evolution of electrocatalysts by using *in situ* or *operando* X-ray absorption spectroscopy. This work is led by Benedikt Lassalle and carried out on the ROCK and SAMBA beamlines.

We will show the advances made in these three projects and propose new upcoming ones.