

A Microfluidic Platform for Synchrotron X-ray Studies of Proteins

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New tools are needed to allow for complex protein dynamics studies, especially to study proteins in their native states. In the AdaptoCell project¹ a microfluidic platform for academic and industrial users at MAX IV Laboratory is being developed. MAX IV is a Swedish national laboratory providing brilliant synchrotron X-rays for research. Due to the high photon flux, sensitive samples such as proteins are prone to rapid radiation damage; thus, it is advantageous to have the liquid sample under flow to refresh the sample continuously. This, in combination with small volumes, makes microfluidics a highly suitable sample environment for protein studies at MAX IV. The AdaptoCell platform is being integrated at three beamlines: Balder (X-ray absorption/emission spectroscopy), CoSAXS (small angle x-ray scattering) and MicroMAX (serial synchrotron crystallography). Currently, the platform is fully available at Balder, under commissioning at CoSAXS and being developed for MicroMAX.

In Figure 1a an illustration of the platform is shown. As well as at the beamlines the microfluidic equipment is also available at the off-line test station in the BioLab. This facility allows for the offline testing and optimisation for the devices with user specific samples and to “health check” the protein samples before the beam time. Suitable AdaptoCell devices are now commercially available via a mainstream manufacturer. The majority of the devices are made of COC (cyclic olefin copolymer), which have high X-ray transmission and high resistance to X-ray induced damage. One key challenge is to avoid contact of the sample with the channel walls in order to prevent fouling, current investigations are focussing on different methods of avoiding this contact (Fig. 1b and 1c). In addition to the sample presentation from the devices at the beamlines, different add-on techniques are also being developed, such as on-chip mixing (Fig. 1d) to e.g., induce rapid pH changes. Later in the project, UV-vis spectroscopy read-out will be integrated to allow additional research data and superior sample control.

The AdaptoCell platform is a convenient sample environment available for MAX IV users that the project team believes will open up for new types of structural and functional studies of proteins.

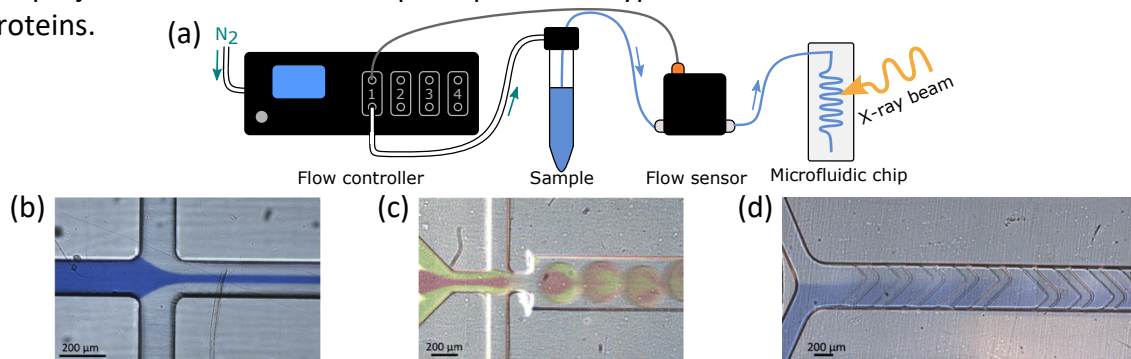


Figure 1. (a) The AdaptoCell platform. (b) Hydrodynamic flow focusing of sample. (c) Generation of water-in-oil droplets. (d) On-chip mixing in a herringbone micromixer.

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