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Abstract

A hydrodynamic focusing microfluidic device for protein analysis using x-ray spectroscopy studies

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Abstract:

Microfluidics has become an integral part in almost all fields because of its highly controlled and integrated features alongside volume reduction and ease of handling. MAX IV Laboratory, the Swedish synchrotron facility for research, enables time-resolved in situ studies of proteins by several techniques. Balder, CoSAXS and MicroMAX beamlines designed to be state-of-the-art in their respective method: X-ray Absorption/ Emission Spectroscopy (XAS/XES), Small Angle X-ray Scattering (SAXS), and Serial Synchrotron crystallography (SSX). Here, the development and evaluation of microfluidic device for hydrodynamic flow focusing of protein samples on high-intense beams for XAS in both X-ray Absorption Near Edge Spectroscopy (XANES) and Extended X-ray Absorption Fine Structure Spectroscopy (EXAFS) is presented. It is also found that to integrate microfluidic devices with highly collimated and brilliant X-rays in synchrotron facilities, there needs to be a lot of considerations on the material of fabrication, design compatibility to be mounted on the beam hutch, fluid dynamics and data collection. The device is fabricated with polyimide foil and tape, as polyimide is X-ray inert. Three layers of films are laser cut and sandwiched to form a microfluidic channel for flow focusing. The channels are 300 x 125 um, in order to have optimal path of length of the intense beams. Initial tests are done on the device using Haemoglobin (Hb) proteins of Equine origin for their commercial availability and metallo-protien nature (Fe), which is the mandatory requirement for X-ray spectroscopy technique. The synchrotron facility at MAX IV allows any user to tune the beam according to the excitation energy and hence 7 KeV was used with the samples of Hb. Samples at various molar concentrations were excited and observed that the device was optimal for low concentrations like 0.1 mM. The spectra were analysed and found that the device can be used in metallo-protein analysis from any higher or lower concentrations, without any radiation damage to the sample and the device, thus providing 100% sample recovery at the end of the experiment. This is vital when using samples that are precious. And the device becomes reusable and sustainable when the cleaning protocol is followed to thoroughly wash any residue from the pervious experiments.

Biography:

Pushparani Micheal Raj has completed her PhD at the age of 35 years from University Magna Grcia of Catanzaro, Italy and doing her postdoctoral studies from MAX IV Laboratory Lund University, Sweden. She is working on development of flow cells for protein analyses using X-ray spectroscopy studies, which will be used by the User Community at MAX IV Laboratory. Her main research interests are micro/nanofabrication, Lab-on-chip, biosensors, automation and analysis.

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