

MS09-1-5 VMXm: a new micro/nanofocus protein crystallography beamline at Diamond Light Source
#MS09-1-5

A. Crawshaw¹, A. Warren¹, J. Trincao¹, M. Lunnon¹, G. Duller¹, G. Evans¹
¹Diamond Light Source - Didcot (United Kingdom)

Abstract

The Versatile Macromolecular Crystallography Microfocus (VMXm) beamline is a new micro/nanofocus beamline joining the suite of macromolecular crystallography beamlines at Diamond Light Source. The beamline has been designed to enable rotation data collection from microcrystals down to 0.5 microns in size. The beamline had its first users in Autumn 2018 and currently a user commissioning call is open for microcrystals measuring <10 µm in any dimension. The beamline optics deliver a beamsize of 0.4 - 9 µm vertically and horizontally between 1.3 - 13 µm to the sample position. The beamline operates at energies between 10-22 keV, delivering ~10¹² ph/s to the sample (at 12.5 keV). VMXm is equipped with two detectors, a Pilatus3 6M (Si sensor) and an Eiger2 X 9M (CdTe sensor) which are fully interchangeable. The quantum efficiency of the CdTe detector is improved at higher energies compared to the Si detector. As such, it is possible to exploit photoelectronic escape from microcrystals using higher energy data collections, which in turn can prolong the lifetime of the crystals in the beam.

Microcrystals are prepared on electron microscopy grids using techniques borrowed from cryo-EM, including grid blotting and plunge freezing using liquid ethane. Samples are prepared in advance of beam time using the VMXm support laboratory, with grid preparation being validated through visualization using an offline Scanning Electron Microscope (SEM). Once grids are introduced to the beamline, crystals can be visualized and aligned to the X-ray beam using either an on-axis optical microscope or the integrated SEM. Signal-to-noise of the diffracted X-rays is greatly improved due to the mounting technique of the crystals which are held under vacuum for diffraction measurements, reducing background scatter to a minimum.

An outline of the beamline will be shown along with recent data collection results. The beamline has been used to collect data on crystals ranging from 2-5 µm in size. The first novel structure has recently been solved using Se derivatized samples. We have also seen improvements in microcrystal data collections where previously data was solved from 20 small wedges of merged data. Here, we were able to exploit photoelectron escape and low background images to solve the structure to a higher resolution from a single crystal.