Poster Presentation

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Room Temperature Serial Crystallography at Synchrotrons

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Serial Femtosecond Crystallography (SFX) is the most commonly used method for the emerging structure determination at X-ray free-electron lasers (FELs). The high peak brilliance of the FEL and the possibility of using femtosecond pulses afford use of nano-to-micron sized crystals in a diffraction-before-destruction approach for the acquisition of high-resolution undamaged diffraction data [1]. The crystals are obliterated upon exposure to an FEL X-ray pulse so only a single snapshot can be collected per crystal, necessitating a constant supply of fresh crystals. The crystals are therefore injected in a liquid microjet [2], [3]. We show that this serial method of data collection and the associated data analysis can be successfully adapted to serial crystallography (SX) measurements at synchrotrons, enabling room temperature studies using the unattenuated beam. Given the continuous supply of fresh crystals, the full tolerable dose can be used for each single crystal exposure, permitting analysis of small or weakly scattering crystals. FEL X-ray pulses are much shorter than the fraction of a second exposure time at a synchrotron, so SFX injection conditions are modified in SX such as to slow down the typically fast travelling crystals. By embedding the crystals in a viscous material the crystals remain in the beam long enough to yield measurable diffraction and smearing out of the diffraction peaks due to crystal tumbling is avoided. We demonstrate the successful application of room temperature SX at the Swiss Light Source at ambient pressure. Our experimental setup allows collection of both still and rotation data. Recent progress using model systems will be presented, establishing this high throughput, high dose rate approach as a new route to structure determination of macromolecules in their native environment and at room temperature.

[1] *Boutet S, et al. (2012) High-resolution protein structure determination by serial femtosecond crystallography. Science337(6092):362–364,* ***[2]*** *Weierstall U, et al. (2012) Injector for scattering measurements on fully solvated biospecies. Rev. Sci. Instrum. 83, 035108,* ***[3]*** *Weierstall U, et al.(2014) Lipidic cubic phase injector facilitates membrane protein serial femtosecond crystallography. Nature Communications 5 3309 doi:10.1038/ncomms4309*

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