Picosecond Snapshots of Chemical and Biochemical Reactions Using Pulsed Synchrotron Radiation

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All proteins undergo structural changes while carrying out their biological function. While the "before" and "after" structures are known for some proteins, the pathway connecting these limiting structures is largely unknown and, until now, unexplored. The ability to watch macromolecular structural changes as they occur has recently been developed on beamline ID09 at the ESRF. A pump-probe set-up has been built for time-resolved studies of photo active molecules.[1] A “two-colour” interaction point at the sample position is produced which consists of 100-femtosecond optical pulses and 100-picosecond x-ray pulses which run at up to 900 Hz and where the relative phase can be set with 2.5-picosecond resolution. The set-up comprises a synchronous x-ray chopper and a Ti:sapphire laser with a large tunability between 400-850 nm. The beamline has so far been used for single shot Laue diffraction of photo reversible systems such as ligand release in heme proteins and studies of intermediates in the photo cycles of bacteriorhodopsin and the yellow protein PYP. The potential for time-resolved studies of protein kinetics in solution using EXAFS and diffuse scattering will be discussed.

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[1]“Time-resolved Structures of Macromolecules at the ESRF: Single-pulse Diffraction, Stroboscopic Data Collection and Femtosecond Flash Photolysis”,
M. Wulff, F. Schotte, G. Naylor, D. Bourgeois, K. Moffat and G. Mourou
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