Time-resolved pump-probe setup on a high-flux XAFS beamline P64

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Photophysics and photochemistry of transition metal (TM) compounds have been an object of fundamental and applied research for decades. As a result, photocatalytical reactions using TM complexes became an important branch of modern chemical technology. However, time-resolved optical methods used to study molecular processes in real time can deliver only limited structural information. In this regard, experimental tools using X-rays with their structural sensitivity add broad possibilities in material research. Among experimental techniques, X-ray absorption spectroscopy (XAS), in particular, is sensitive to local structure, while X-ray emission spectroscopy (XES) has sensitivity to atomic spin. Additionally, these techniques can be applied to samples in liquid medium, which is especially important for monitoring reactions *in situ* in biochemical applications and catalysis. Extending X-ray methods into a time-resolved pump-probe regime, where the sample system is probed after an optical excitation, opens new possibilities for investigation of structures of short-living photoinduced states.

Following the user interest in studying molecular processes on 100 ps – μs time scale, we are building a pump-probe setup at high-flux XAFS beamline P64. Feasibility and relevance of such experiments was demonstrated by operation of pump-probe setups at various synchrotron radiation facilities as well as worldwide emergence of free-electron laser facilities oriented on time-resolved studies. Possibility of laser pumping will come as an add-on to setups already existing at P64 such as XAS and XES [1,2,3].

The pump-probe project is a collaboration between beamline P64, Uni. Paderborn (M.Bauer) and Uni. Hamburg (M.Rübhausen) with a financial support of two BMBF projects. The first project is related to the beamline P64 preparation for the pump-probe measurements; the second is dealing with the installation of the optical pump system. The following objectives will be realized within the scope of the first project: (1) the beam positional stability will be improved; (2) horizontal focus size of ~230 μm will be reduced down to ~20-50 μm. Additional preparations at the beamline will be done in the areas of sample environment and data acquisition.

References

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