Structural and Dynamical Behaviour of Water in (and on) Nano-confined Systems

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Time-resolved spectroscopic investigations as well as investigations based on time-resolved x-ray diffraction techniques reveal new insides into the structural dynamics of matter. In this contribution we will present our studies on nanoconfined media like ternary liquid crystal systems (as membrane model systems), or proteins. We will discuss how water solvation shells (in the case of proteins) or the water (structure) itself influences the kinetics and dynamics of the systems mentioned.

Special emphasis will be focused on the ultrafast structural response function of water as been investigated at the Free Electron Laser Facility FLASH at DESY. The remarkable coherent and brilliant properties of this source (100 % transversal coherence, up to 10^{12} photons / pulse) - combined with its time resolution (30 – 100 fs) provide a unique opportunity to elucidate short living structural intermediates and states. The experiments carried out were based on a pump / probe scheme where a femtosecond optical laser excites the system of investigation and the FLASH soft x-ray pulse (7 nm) probes its structural response function by XUV diffraction techniques. The available energy range (EUV-Soft X-rays) makes it furthermore possible to investigate fundamental processes, such as inner shell photon ionization or the structural response function of matter under extreme laser fields. Early intermediates of radiation chemistry (like solvated electrons) have been observed by applying the experimental scheme of FLASH pump / optical laser probe in the ultrafast time domaine.