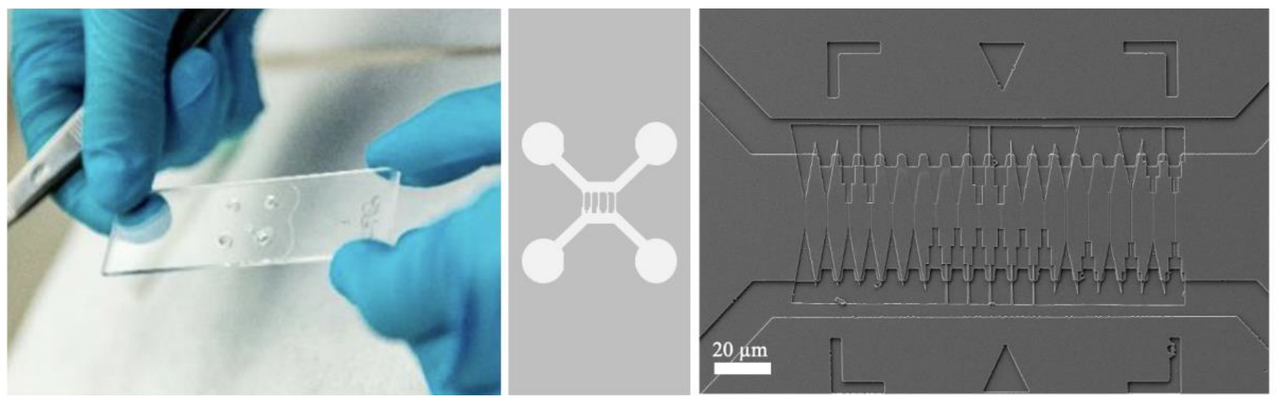
CHYN MEETS HARBOR

High Throughput DNA Optical Mapping in Real-Time on 3D Nanofluidic Devices - Franziska Esmek

A setup for FLASH Liquid-phase Ultrafast X-ray Spectroscopy (FLUXS) - Ru-Pan Wang

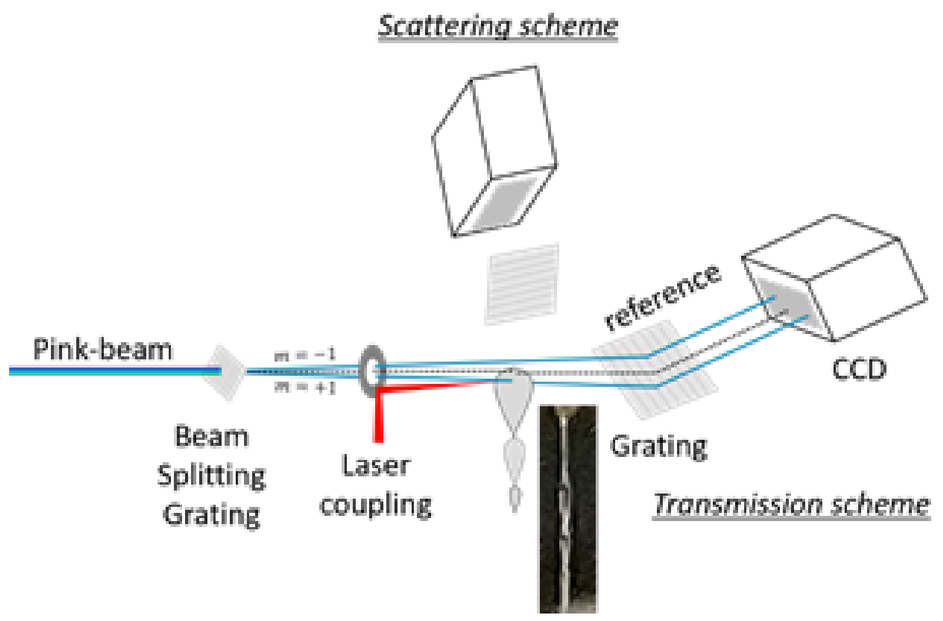
Abstract Talk 1: Part 1: DNA optical mapping is a powerful tool for analyzing long-range structures and the length of DNA in a reasonable time. It allows studying intact single DNA molecules in a cost-efficient way, with a variety of applications in many different fields. [1]We have developed a technology called laser-assisted DNA optical mapping (LADOM methodology) for analyzing the long-range structure of single DNA molecules. Within the LADOM method, an optical map on single DNA molecules is generated and read out by a laser system. First, the molecules are stained with an intercalating dye and diluted in TBE buffer. A droplet of the solution is put on the nanofluidic device into the micro and nanochannel area. With the help of 3D inlets, the DNA molecules are guided in the nanochannels without any external forces like applying an electric field or pressure. The inlets also pre-stretch the molecules, which avoids clogging. A spot-like laser is focused in the center of a nanochannel. As the DNA is flowing through the laser spot, a photo detector measures the fluorescence emitted by the intercalating dyes. The obtained signal provides information about the length and barcode of the DNA molecule. It also gives information about the conformation of the DNA inside the nanochannel (e.g., hairpin and other folded variations).

We have designed and fabricated micro and nanofluidic structures in a multistep process in a silicon stamp, which is then transferred in a polymer stamp, which allows for the fabrication of single-use samples in a 2 minutes process.[2, 3] The polymeric chip consists of micro/nanostructured fluidic channels, and several inlet holes, to insert the liquid (Fig.1). The microchannels guide the DNA from the holes into the nanochannels, which differ in cross-section, length, and geometry.



Abstract Talk 2: The project aims at building a versatile liquid-phase spectroscopic instrument for advanced ultrafast solution-phase spectroscopy in the soft X-ray regime (200 to 1000 eV) at FLASH, the XUV and soft X-ray free-electron laser at DESY in Hamburg. This provides opportunities to study the transient charge or spin dynamics of molecules and nanoparticles as well as the photochemistry of solvents for the worldwide user community.

A compact and flexible spectrometer allows to switch between transmission and inelastic scattering spectroscopy. In combination with novel beam splitting techniques for referenced detection, the end station enable (i) self-referenced X-ray absorption spectroscopy (XAS) with monochromatized X-rays pulses near the shot-noise limit, (ii) pink-beam post-sample self-referenced dispersive X-ray absorption spectroscopy (dXAS) in transmission mode, (iii) partial fluorescence yield (PFY) absorption spectroscopy for low-concentration samples, (iv) pink-beam X-ray emission spectroscopy (XES), and (v) resonant inelastic X-ray scattering (RIXS) with moderate energy resolution across the whole photon energy range of FLASH. We have successfully demonstrated for the first time this self-reference approach for solutions using the two first-order beams of a soft X-ray transmission grating guided through and past a liquid flat jet, respectively [1]. Importantly, this instrumentation concept entails uncompromised time resolution for dXAS at beamlines without a monochromator.



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