Focus-Panel "Hydrodynamics of Flowing Fluids: Micro- and Nanofluidics"

X-Ray Studies of Bio-Matter in Microfluidic Sample Environments

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Biological systems such as for example cells and cellular components are governed by processes which take place on the nanometer to micrometer length scales. X-ray scattering and diffraction techniques are extremely well suited to study these processes as the spatial resolution extends well into the relevant length scales. At the same time, the investigation of such systems, in particular in the field of the biophysical research requires well-defined and controllable sample environments. One way to establish such environments is by employing continuous flow microfluidic devices tailored for the particular experiment.

We will present experiments which take advantage of different flow regimes. At high flow velocities, shear rates of up to 10^{-7} s^{-1} can be reached. Multilamellar lipid assemblies align with the membrane normals oriented along the velocity gradient of the jet. The results indicate that the setup may be well suited for coherent diffractive imaging of oriented biomolecular assemblies and macromolecules at the future x-ray free electron laser sources.

At much smaller flow rates, laminar diffusive mixing of biomacromolecules and smaller reactants leads to very controlled gradients. Such defined chemical environments are employed to study the assembly dynamics and kinetics of proteins into aggregates or fibers. We will present recent experiments on the formation of cytoskeletal intermediate filaments (IF) from vimentin IF proteins.