Analysis of complex fluids using microfluidics: the particular case of DNA/polycations assemblies

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Most of biological systems and environments belong to the category of complex fluids. In order to explore these sophisticated systems in the laboratory, microfluidic technologies have been developed, improved and applied in recent years. Microfluidics provides advantages such as small sample volumes, shorter reaction and analysis times, and being an effective instrument to study complex fluids in situ. Making use of the unique combination of microfluidics with optical, spectroscopic and scattering techniques, we study the dynamic self-assembly of DNA with biologically and biotechnologically relevant polycations. Due to the laminar flow in the microdevices, the mixing of DNA with PPI4 dendrimers or linker histone H1 is controlled by molecular diffusion. The dynamics of the self-assembly process is characterized on the molecular level using Raman micro-spectroscopy. In parallel, the structural evolution of the formed DNA/polycation assemblies is probed by microfocused small-angle x-ray diffraction. Moreover, analysing the x-ray diffraction data in more detail, we find a positive impact of the microflow on the mesoscopic structure and orientation, and therefore on the characterization of the self-assemblies.
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