Single-molecule approaches to study viral self-assembly in real-time

Wouter Roos

1. Abstract

Viral self-assembly is a fascinatingly complex processes and we are still at the beginning of our understanding of how assembly works. Using (High Speed) Atomic Force Microscopy (HS-AFM) and fluorescent Optical Tweezers we are now able to scrutinize the dynamics of these processes at the nanoscale, in real time, in liquid. I will show how we are using these techniques to study the intricate physics of self-assembly. This will be illustrated by discussing dual-trap optical tweezers studies of the self-assembly of virus-like-particles (VLPs) that reveal real time binding of capsid proteins to a genome and the formation of stable VLP structures around the genome. Furthermore, using high speed AFM visualization, the formation dynamics of 2D capsid protein assemblies is analysed, particularly revealing how complex the kinetics of viral self-assembly can be, with multiple assembly pathways and continuously occurring assembly and disassembly events. Finally examples of other self-assembly processes will be discussed and how they can be studied using singe particle approaches.