Single Walled Carbon Nanotubes as a Scaffold to Concentrate DNA for Studying DNA-Protein Interactions

Zunfeng Liu, Remus Th. Dame, Jan Pieter Abrahams
Gorlaeus lab, Leiden Institute of Chemistry, 2300RA, Leiden University
liuz2@chem.leidenuniv.nl

The genomic DNA in bacteria exists in a condensed state, which exhibits different biochemical and biophysical properties from a dilute solution.[1] In this paper, DNA was concentrated on streptavidin-coated single walled carbon nanotubes (Strep•SWNTs) [2,3] via biotin-streptavidin interaction. We reasoned that confining DNA within a defined space via mechanical constraints, rather than by manipulating buffer conditions, would more closely resemble physiological conditions. By ensuring a high streptavidin loading on SWNTs of about 1 streptavidin tetramer per 4 nm of SWNT, we were able to achieve dense DNA binding. DNA is bound to Strep•SWNTs at a tunable density, and up to as high as 0.5 mg ml-1 in solution and 29 mg ml-1 on 2D surface. This platform allows us to observe aggregation behaviour of DNA at high concentration and the counteracting effects of nucleoid HU protein on the DNA aggregates, as shown in Figure 1. This provides an in vitro model for studying DNA-DNA and DNA-protein interactions at a high DNA concentration.

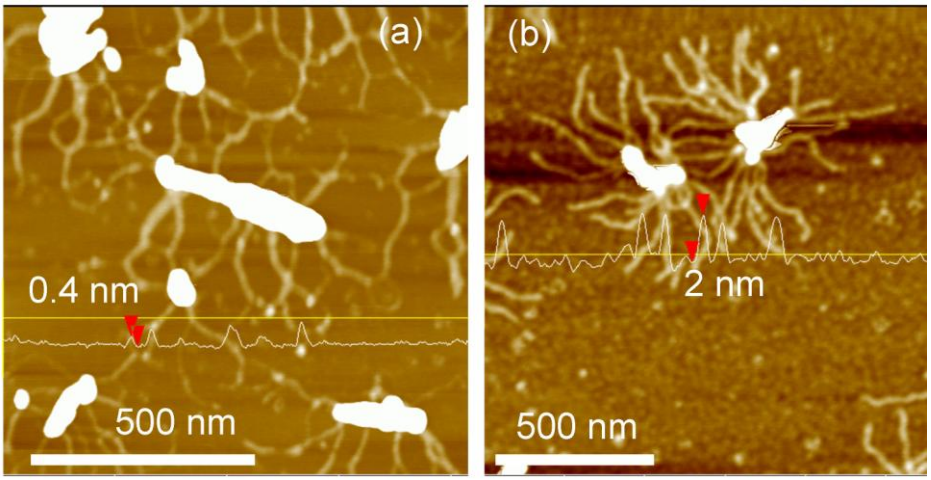

Figure 1. AFM images of bio-DNA captured on Strep•SWNTs on mica (a) and after incubating with nucleoid HU protein (b). The height analysis shows that DNA has a height of ~0.4 nm, which forms aggregates at high concentration, and the height increases to ~ 2 nm after incubating with HU, and the aggregates dissociate. The diameter increase should be ascribed to the formation of HU•DNA complex.

References

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