Probing DNA assembly into nanoparticles with short DNA

Preethi L. Chandran[1,2], Emilios K. Dimitriadis[1], and Ferenc Horkay[1]
[1] Section on Tissue Biophysics and Biomimetics, NICHD,
[2] Laboratory of Bioengineering and Physical Science, NIBIB,
National Institutes of Health,
Bethesda, MD 20892, U.S.A.

ABSTRACT

DNA is an anionic polyelectrolyte, which occupies a large volume in salt free solution due to the coulomb repulsion between the charged groups. In the presence of high valence cations, DNA condenses into nanoparticles. DNA nanoparticles have generated a lot of interest as a preferred vehicle for delivering therapeutic DNA in gene therapy. The efficiency of gene delivery is determined by stability and compactness of the particles. However not much is known about the organization of DNA within the particles. The large polymer cations condense DNA rapidly, with no distinct intermediate stages that give insight into the arrangement of DNA within the nanoparticle. In our work, we form nanoparticles with short DNA strands to slow down the condensation process. The polymer cation is polyethyleneimine with grafted sugar moieties. Distinct intermediate stages are observed with Atomic Force Microscopy. The assembly occurs via the formation of fiber condensates, which appear to be the unit of DNA condensation. Nanoparticles form by compaction of interweaving networks of fiber condensates.