DNA Nanoparticles – structure, assembly and osmotic properties

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 multivalent cations, DNA condenses into compact nanostructures. There has been considerable interest in the DNA condensation process for understanding its packaging in viruses and for creating nano-scale self-assembled structures. Importantly, the Human Genome project and the prospect of combating cancer and hereditary diseases by delivery of therapeutic genes has fuelled interest in nanoparticles formed by condensation of DNA with polycations. Delivering genes by nanoparticles has the advantages of reduced antigenicity and improved target specificity compared to viral modes of gene delivery. In this talk we focus on three aspects of DNA nanoparticle formation and stability. (1) Counterion valence as a tool of modulating DNA assembly into nanoparticles. We discuss how ion valence influences the pathway of DNA condensation into nanoparticles. (2) Organization of DNA strands within the nanoparticles. We determine the morphology of the DNA within the nanoparticles by the Atomic Force Microscope. (3) Stability of DNA in different ionic environments. We estimate the effect of counterions on the osmotic pressure of DNA. This information is important because the interaction between DNA and cations control the efficacy of gene release within the cell.