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Determining the DNA binding properties of nano-scale ruthenium dumbbells using optical tweezers

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Nanoscale small molecules are of interest due to their selective DNA binding properties, which make them potential candidates for chemotherapy. The ruthenium complexes we report are dumbbell shaped molecules with bulky side chains that look like nanoscale propellers. They must thread through the DNA base pairs to reach their final threaded intercalation state. Here we study the binuclear ruthenium complex, ΔΔ-[μ-bidppz (bpy) 4Ru2]4+ and compare it with the previously studied ΔΔ-[μ-bidppz (phen) 4Ru2]4+. Both have the same intercalating bridge unit, but different threading moieties. In this study, we use optical tweezers to trap a single DNA molecule and stretch it in the presence of the ligand at various concentrations. Since threading intercalation is relatively slow process, we hold the DNA at constant force until an equilibrium DNA elongation is reached. The extension of the DNA obtained as a function of time during binding yields the kinetics and equilibrium binding properties of the ligand. The preliminary data suggests that the binuclear complex with 'bpy' in the threading moiety shows stronger affinity and an order of magnitude faster on rate, compared to its counterpart with 'phen' in the threading moiety. This implies that the extra aromatic ring of 'phen' interferes with the threading intercalation process, and also that having bulkier side chain does not increase the affinity of these nano-dumbbells as commonly assumed.

Biography

Dr. Thayaparan Paramanathan is a biophysicist with interests in applying physics techniques to explore biological systems at single molecule level. He received his PhD in physics from Northeastern University and did his postdoctoral work at Brandeis University with Prof. Jeff Gelles, who is considered one of the pioneers in single molecule imaging, and Prof. Jane Kondev, who is a world renowned biophysicist. His research interest in the field of biophysics is to use physics techniques to study biological systems at single molecule level.

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