22nd Iranian Chemistry Conference, 23-25 August, 2023
University of Kurdistan

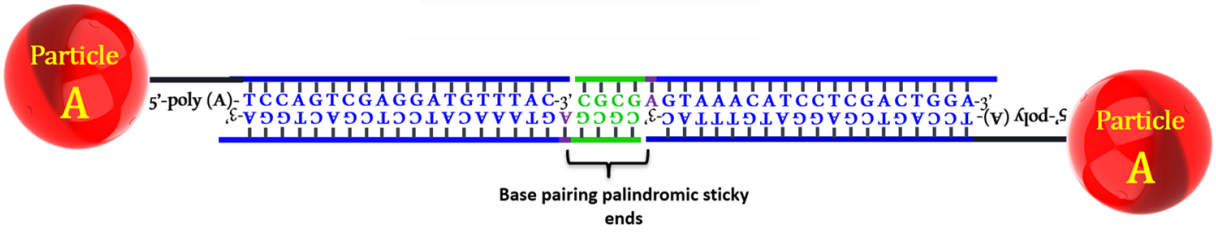
Study of parameters affecting the assembly of linker-based gold nanoparticle core spherical nucleic acids (AuNP-core SNAs) for colorimetric detection

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Spherical nucleic acids (SNAs) are multivalent nucleic acid structures made up of a layer of tightly packed oligonucleotides shells on the surface of a nanoparticle core. Since the first report of SNA by Mirkin et al. [1], there has been great interest in SNAs as they offer new opportunities in the field of gene and drug delivery. The DNA shell allows specific molecular recognition with much higher binding affinity for complementary sequences compared to their linear counterparts which can be programmed to recognize and bind DNA targets. Upon binding, aggregation of AuNP-core SNA red-shifts the surface resonance plasmon (SPR) band and a visible color change of the particles in solution from red to purple is observed. The change in the optical property of gold nanoparticles suspension can be easily monitored with UV-Vis absorption spectroscopy. Colorimetric detection systems based on SNA conjugates have been used for visual detection of nucleic acids with the naked eye [2,3].

In this study, the kinetics of the self-assembly process of gold nanoparticles modified with phosphorothioate-capped oligonucleotides and complementary linker strands with palindromic tails were investigated. The engineered mixture of palindromic DNA linkers and SNA resulted in significant time-dependent spectral changes of the AuNP plasmon band due to self-assembly formation in the presence of the DNA linker. Spectral changes were monitored by tracking the plasmon band of the AuNP core SNA in UV-Vis spectra over time. A series of experiments and a theoretical model were developed to study the assembly kinetics of SNA using 24 linkers of different length and GC content. The kinetics of assembly formation in linker-based single-component systems was found to depend on the length and GC content of the palindromic tail. The result showed that the 4-nucleotide palindromic linker with 100% GC content was suitable for colorimetric purposes due to its faster assembly rate and greater color change in SNA solutions.



References

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