Improvement and Acceleration of DNA Conjugation to Gold Nanoparticles for Target Sensing

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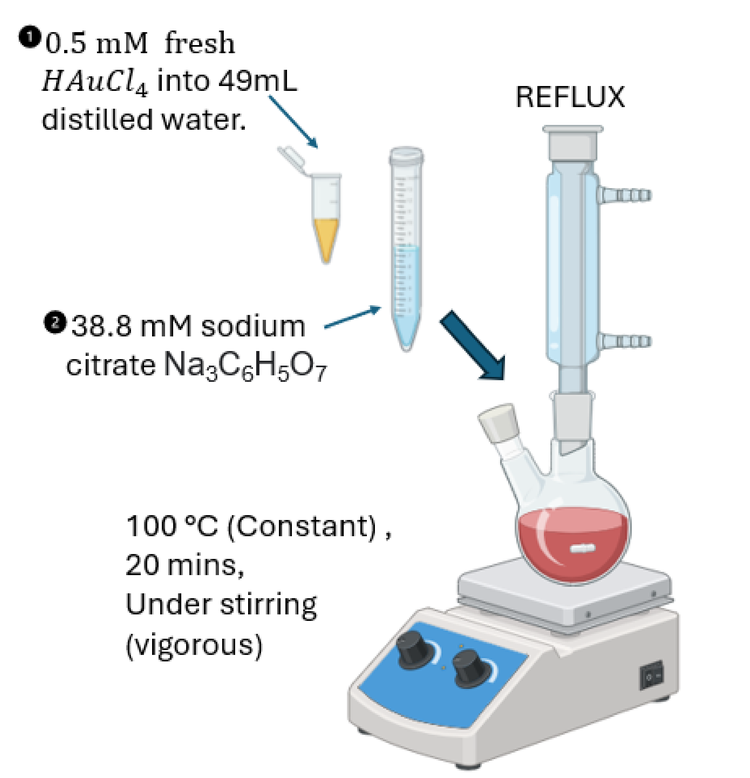
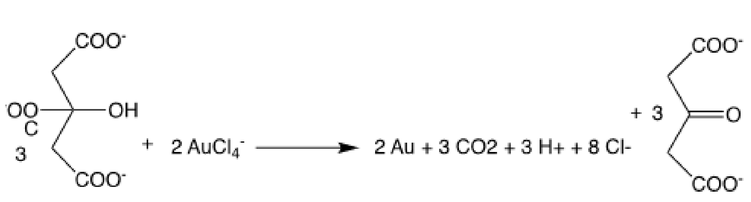
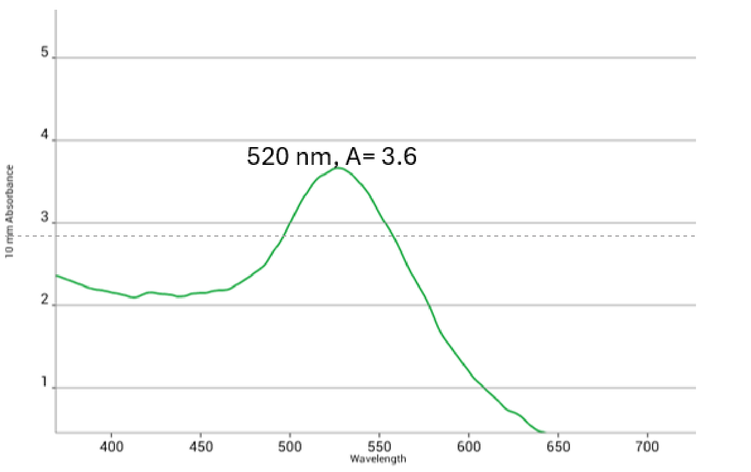
Introduction and Objectives

Advances in technology have heightened concerns about hard-to-detect environmental contaminants, leading to the development of nanotechnology-based biosensors. The bioreceptor system being used in this project is composed of gold nanoparticles (AuNPs) which are functionalized with aptamer oligonucleotides ODNs (short sequences of DNA of binding ability). The key challenge is optimizing the conjugation of AuNPs with oligonucleotides for a good colloidal stability, which will be addressed by refining conditions (temperature, pH, NaCl concentration) and applying them on the freezing-driven conjugation of AuNPs with ODNs.

Gold Nanoparticles AuNPs Synthesis

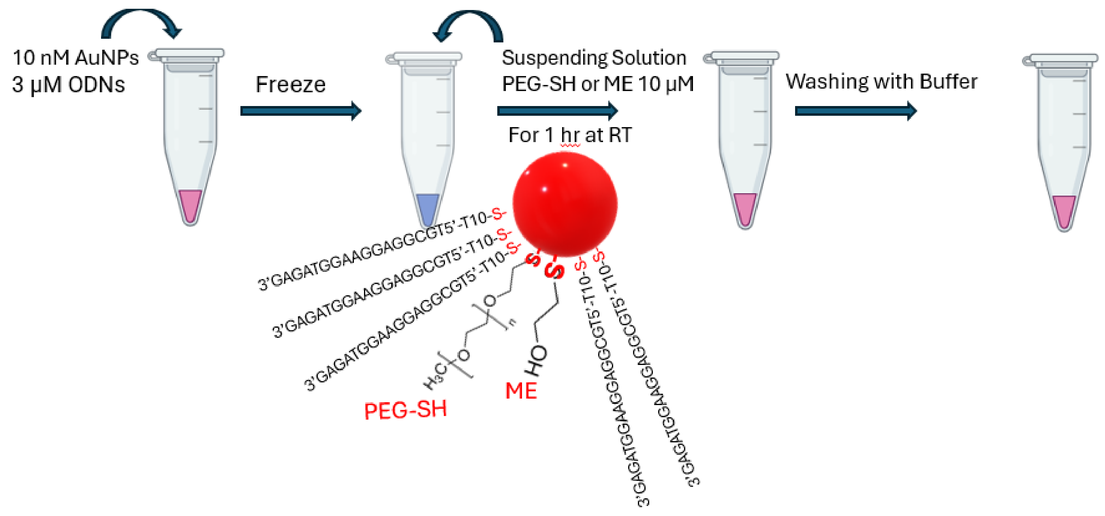




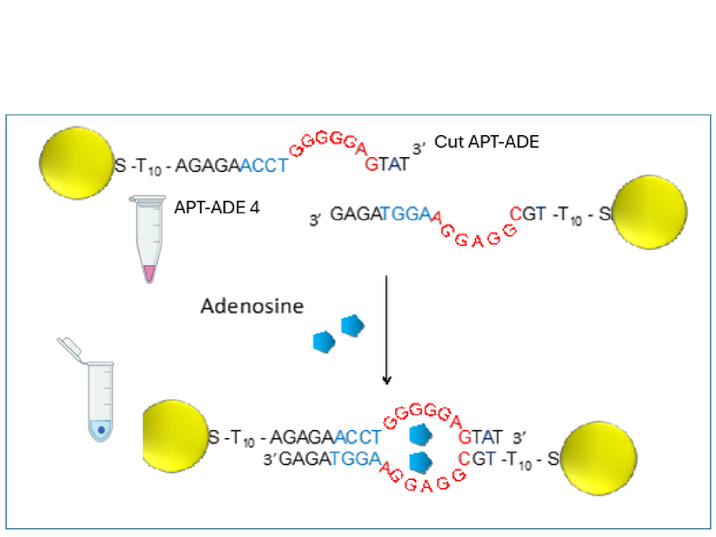


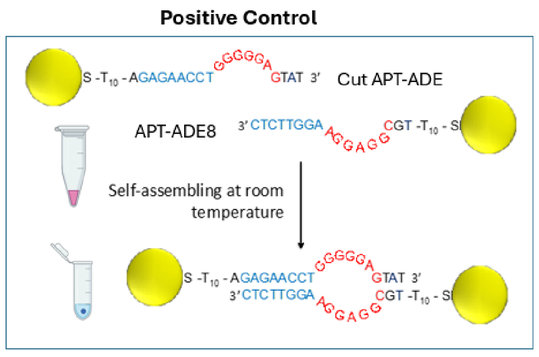
Functionalization of AuNPs with oligonucleotides Using Freezing Method

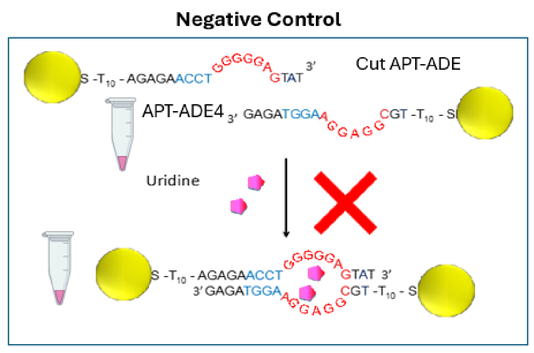
After finding that functionalization using BSPP is sensitive to buffers, expensive and needs time, we were inspired by *Liu. et al*'s work.



Aptamer- Adenosine Assay for Functionalization Verification





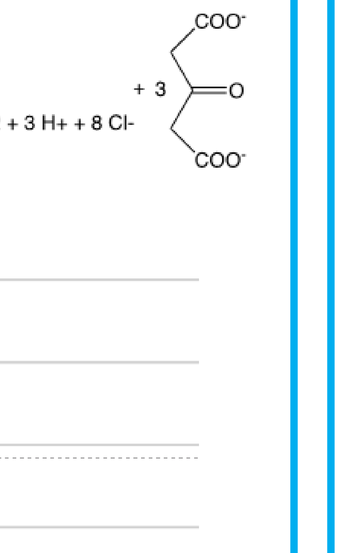


Results

Freezing-Driven Functionalization of AuNPs with ODNs

Following exactly Liu's Protocol:
10 nM AuNPs
3 µM ODNs
Freezing at -19 °C for 2hrs.
ME 10 µM for 1 hr.
HEPES 10 mM + 150 mM NaCl

After Several Improvements on Liu's protocol:
10 nM AuNPs
3 µM ODNs, reduced
Freezing at -78.5 °C for 10 mins.
PEG-SH 10 µM for 1 hr.
HEPES 10 mM without NaCl.



Aptamer-Adenosine Assay

LOD< 1 µM

Conclusion and Future Work

A new protocol for oligonucleotide reduction was developed for efficient functionalization, and the Adenosine detection limit was improved to below 1 µM. The next step is to apply the functionalization conditions to AuNPs with DNAzymes for Pb^2 detection, with SPR imaging used to enhance detection and selectivity for Pb^2 over other metals. **Thanks to the SoftNano Graduate School Program for funding my internship and ESONN for the opportunity to explore new ideas and connections with outstanding individuals.**

References

[1] Liu, Biwu, and Juewen Liu, Langmuir, 2019.
[2] Yoann Roupioz, JCE, 2019, pp. 1002–1007.
[3] Juewen Liu and Yi Lu. ACS, 2004, pp. 12298–12305.