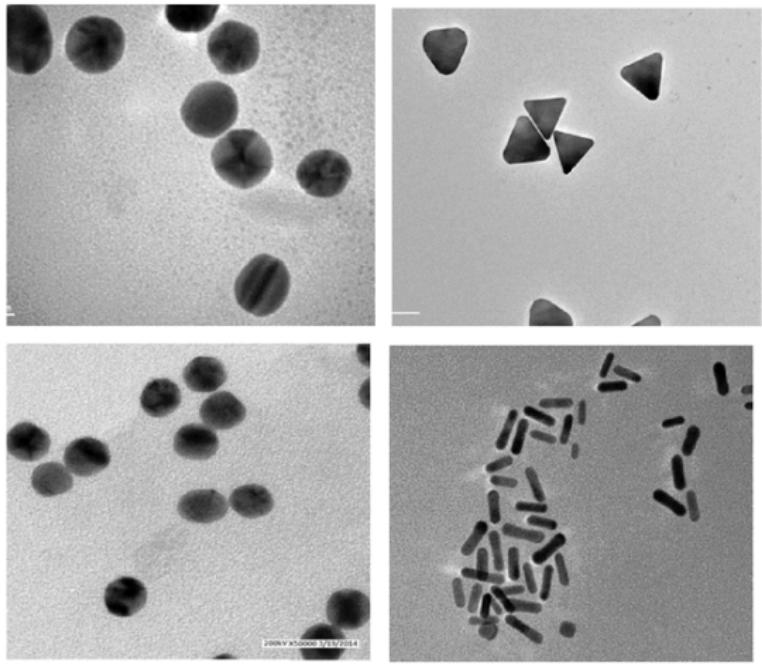


Radiosensitization using gold nanoparticles

Lies Deceuninck en Hannelore Verhoeven

Bachelor Thesis 2016
As. Bert De Roo, Mattias
Vervaele, Stephanie Seré

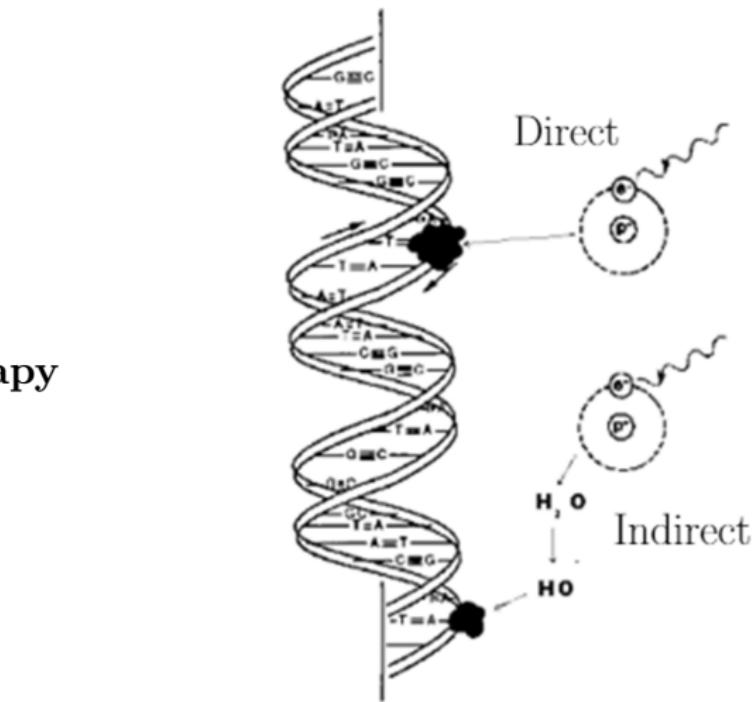
Introduction
Synthesis GNP
Chemical protocol
Size GNP
Stabilization
Characterization



Cancer treatment

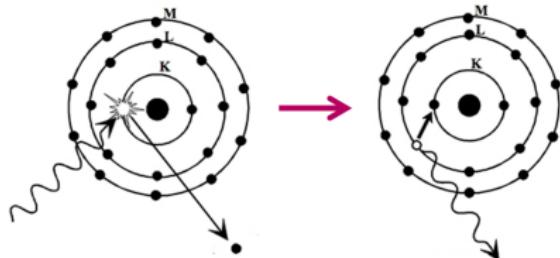
- Chemotherapy
- Surgery
- **Radiation therapy**

Energy $\sim MeV$

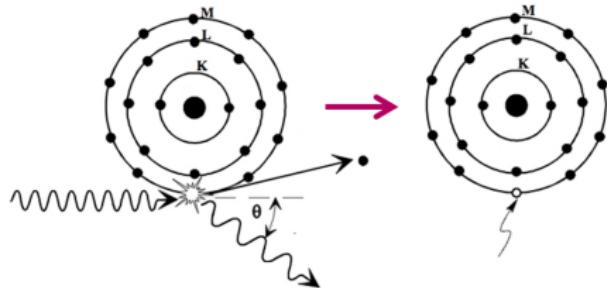


Radiosensitization with GNP_E ~ keV

Photoelectric absorption



Compton effect

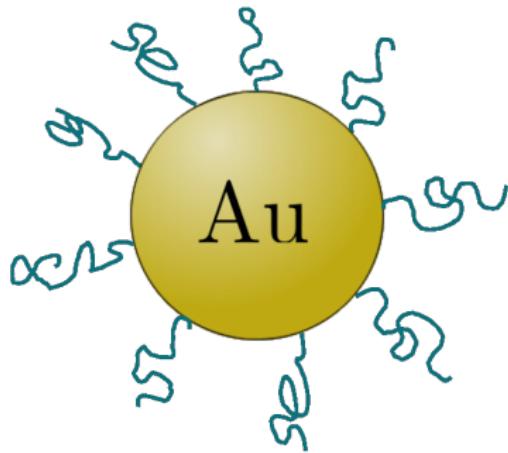


Why gold?

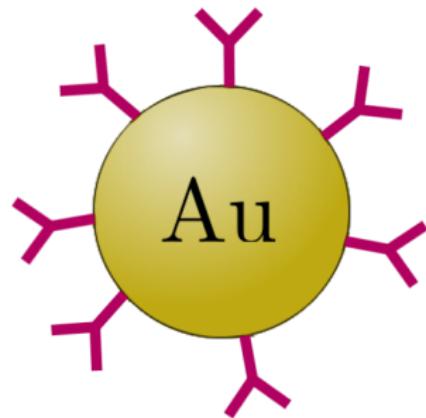
- High atomic number (79)
- Low toxicity

Targeting

Passive targeting
PEG coating

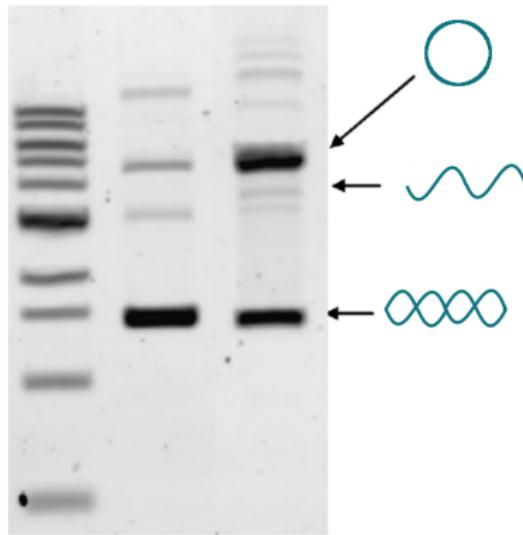


Active targeting
Antibodies



Goal

1. Synthesis
2. Characterization
3. Radiosensitization



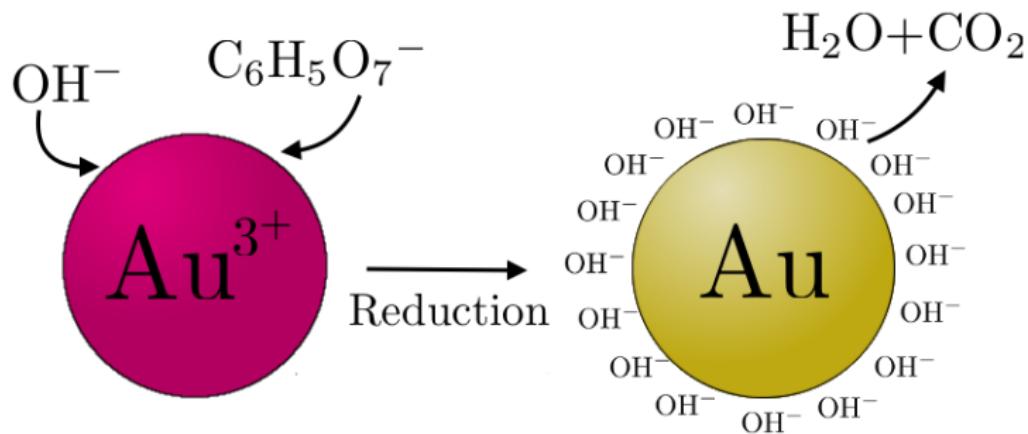
TEM image analysis to determine core diameter



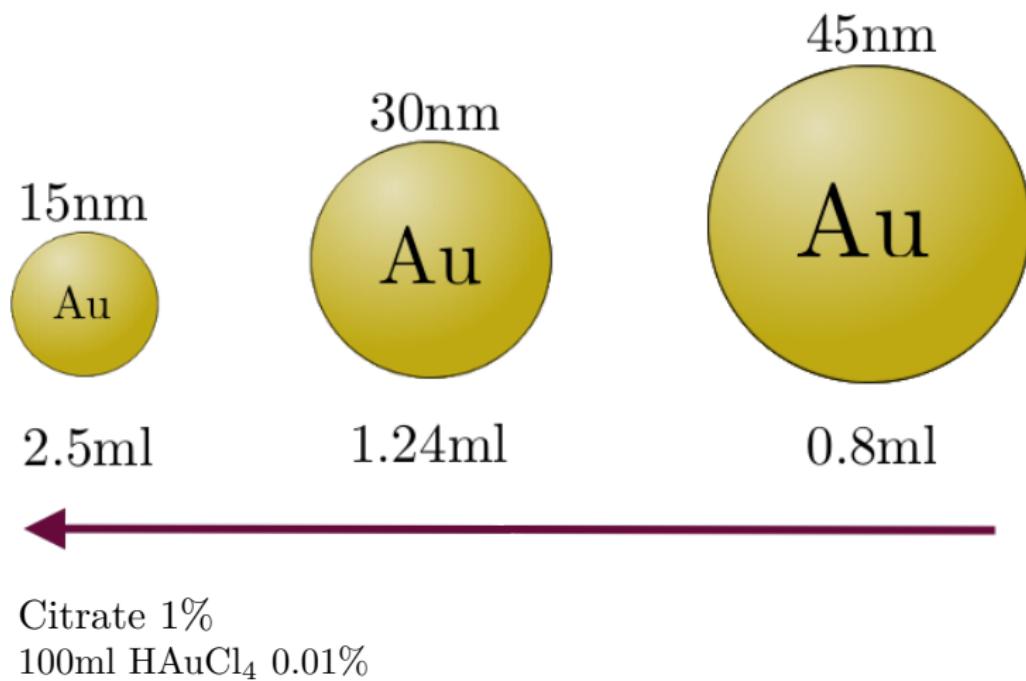
Gold ions: HAuCl₄ solution

Reducing agent: Na₃C₆H₅O₇

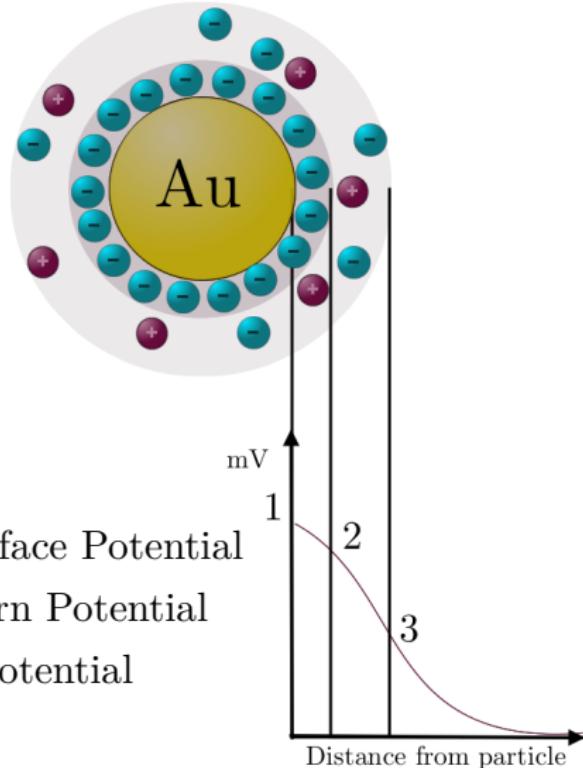
Chemical protocol



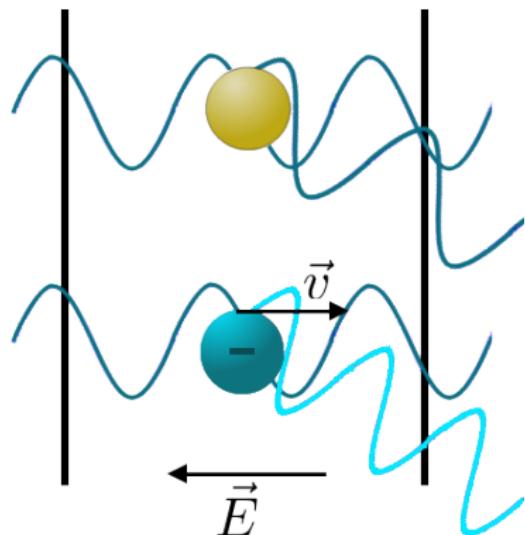
Size GNP



Zeta Potential

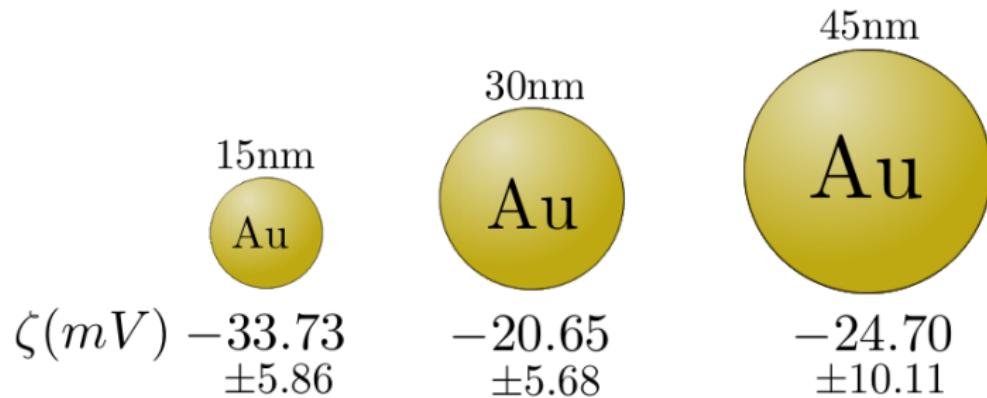


Laser Doppler Gel electrophoresis

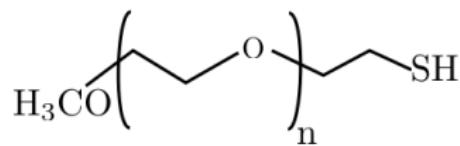
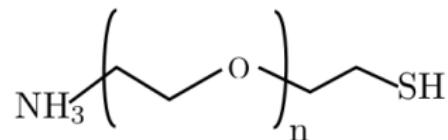
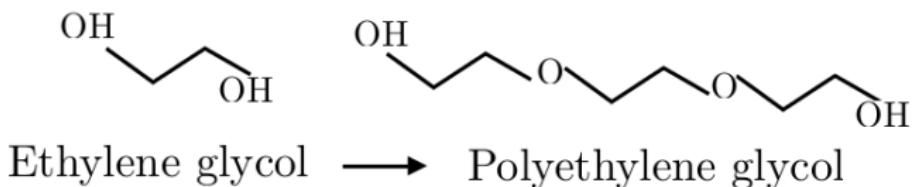


$$\zeta = \frac{2\eta v}{3E\epsilon} \quad |\zeta| \geq 30\text{mV}$$

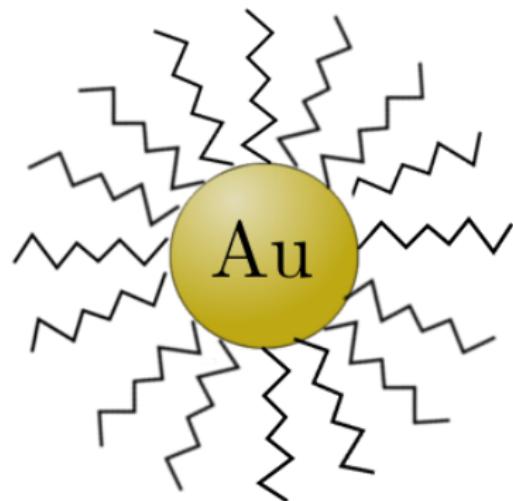
Zeta Potential: Results



Functionalization PEG

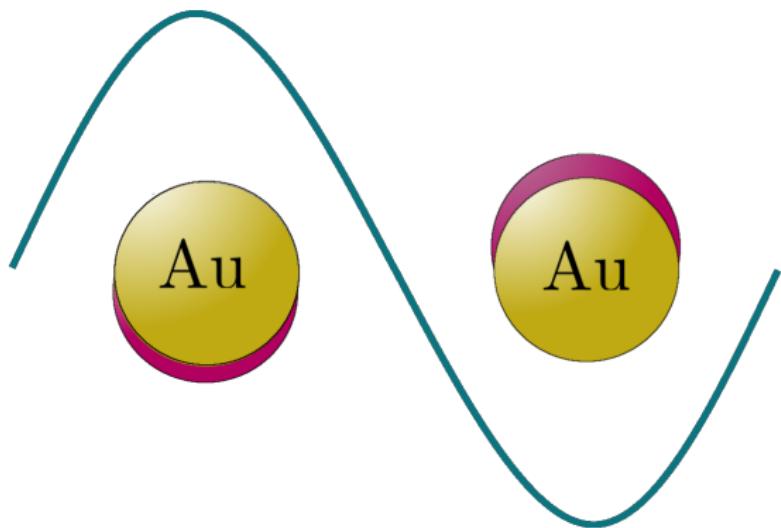


20k, 10k, 5k, 1k



UV-Vis spectroscopy

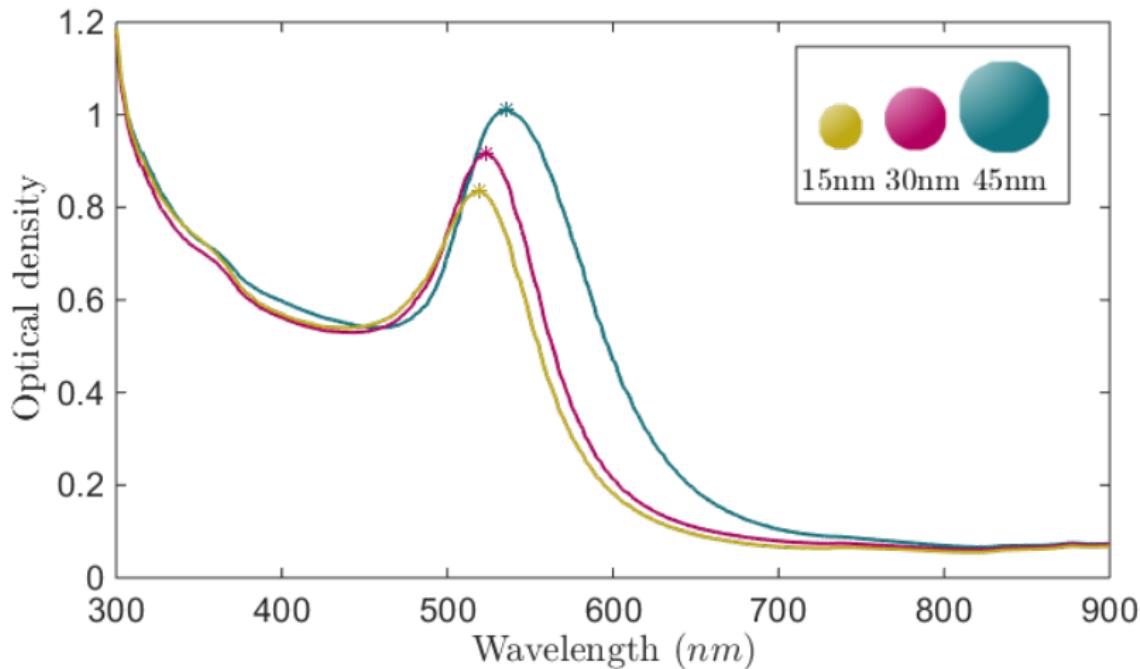
1. Add PEG
2. Size GNP
3. Add NaCl
4. Size GNP



bigger size → too little PEG
same size → enough PEG

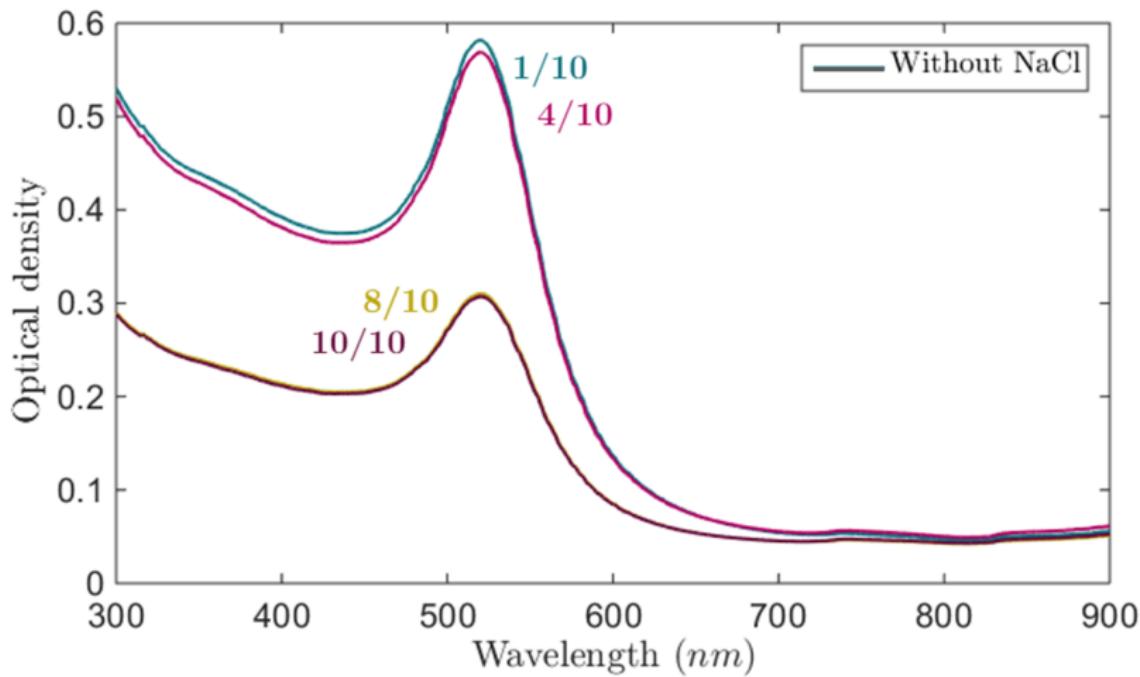
Results

GNP no PEG



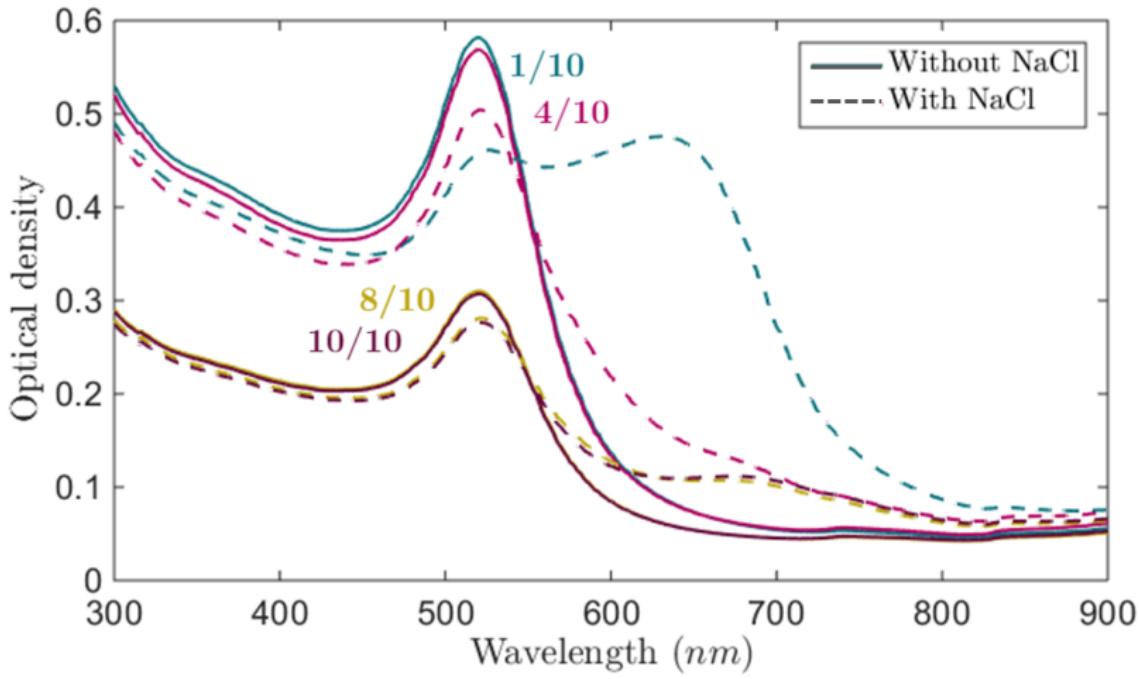
Results

15nm GNP 20k PEG for different PEG/GNP



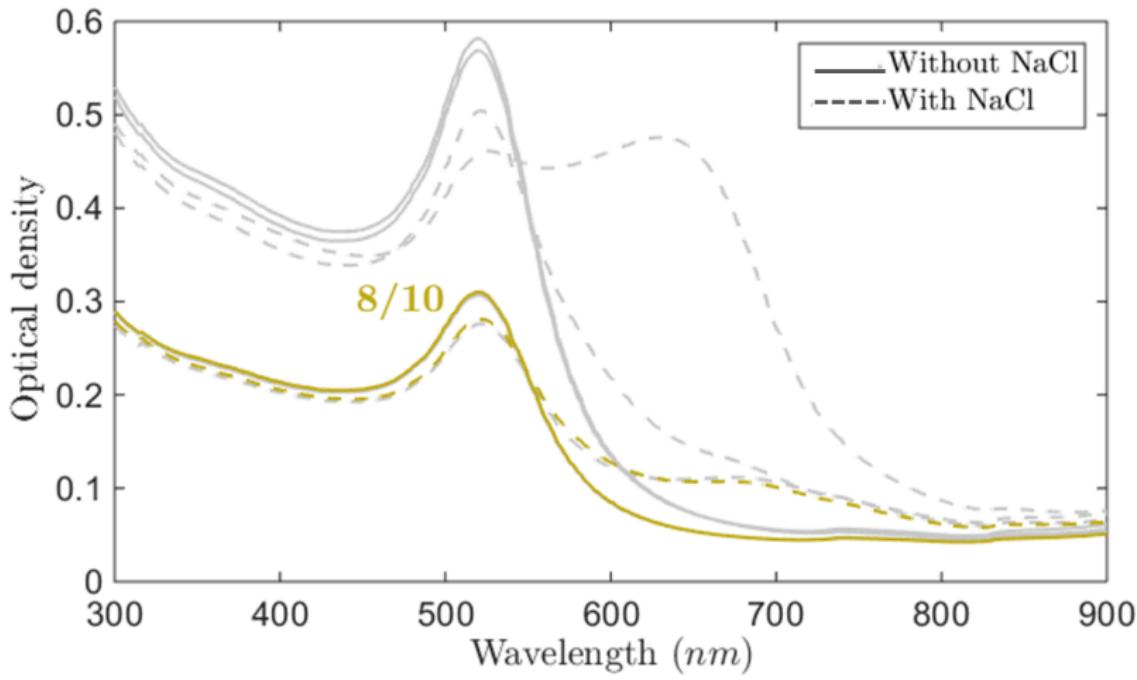
Results

15nm GNP 20k PEG for different PEG/GNP



Results

15nm GNP 20k PEG for different PEG/GNP



Overview

Introduction

Synthesis GNP

Chemical Protocol

Size GNP

Stabilization

Characterization

Size GNP

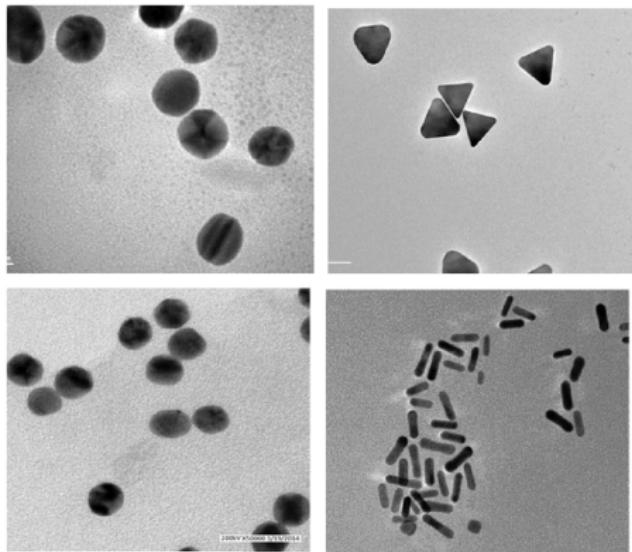
Chemical Protocol

UV-VIS

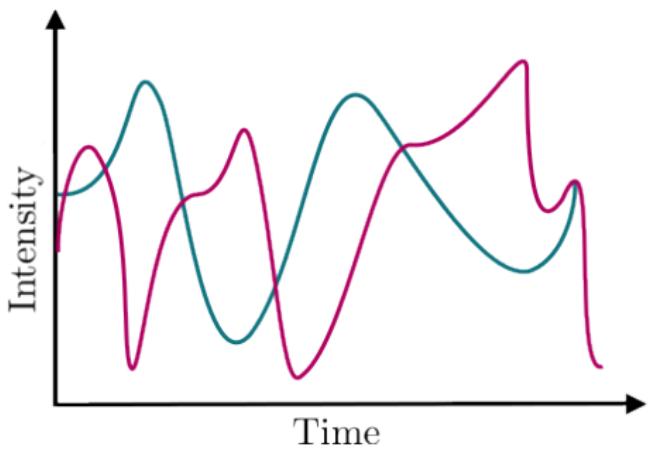
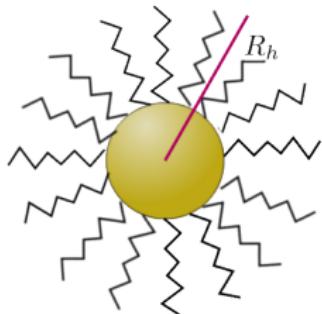
TEM

Hydrodynamic Radius

DLS

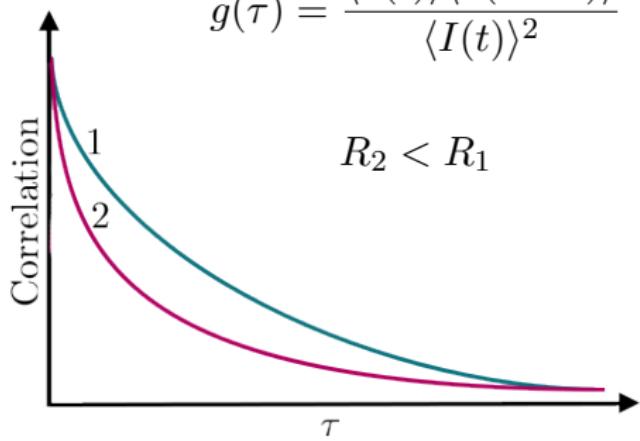


Dynamic light scattering (DLS)



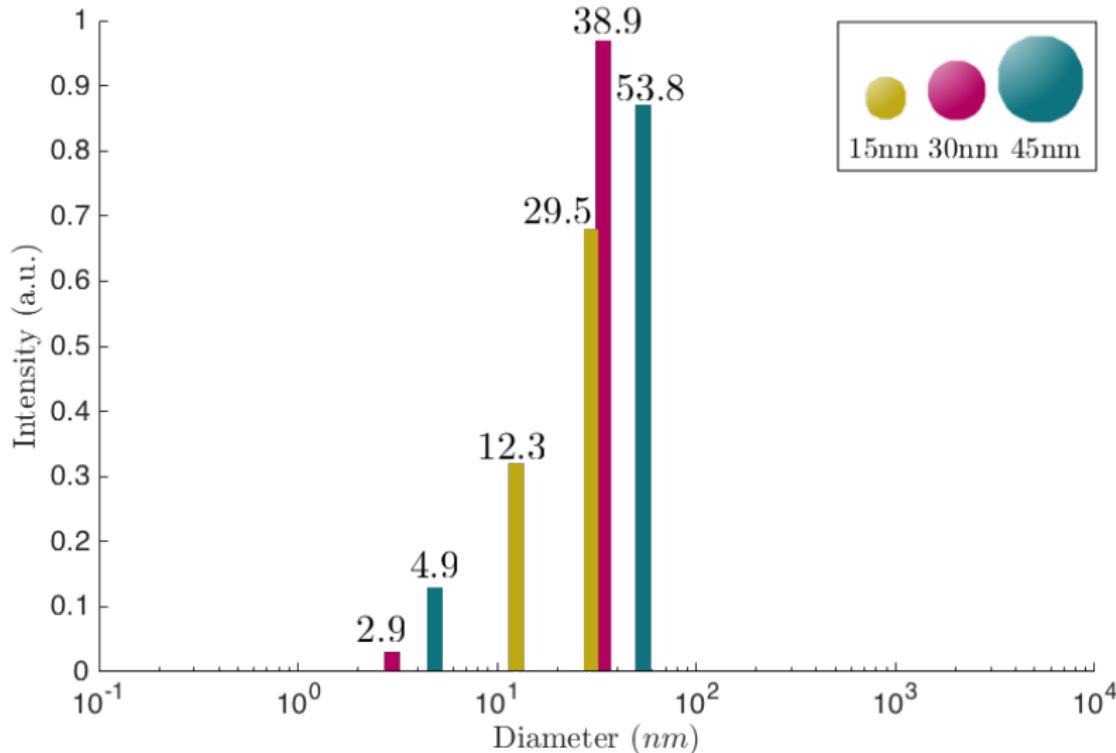
Hydrodynamic radius (R_h)
 → Rayleigh scattering

$$g(\tau) = \frac{\langle I(t) \rangle \langle I(t + \tau) \rangle}{\langle I(t) \rangle^2}$$



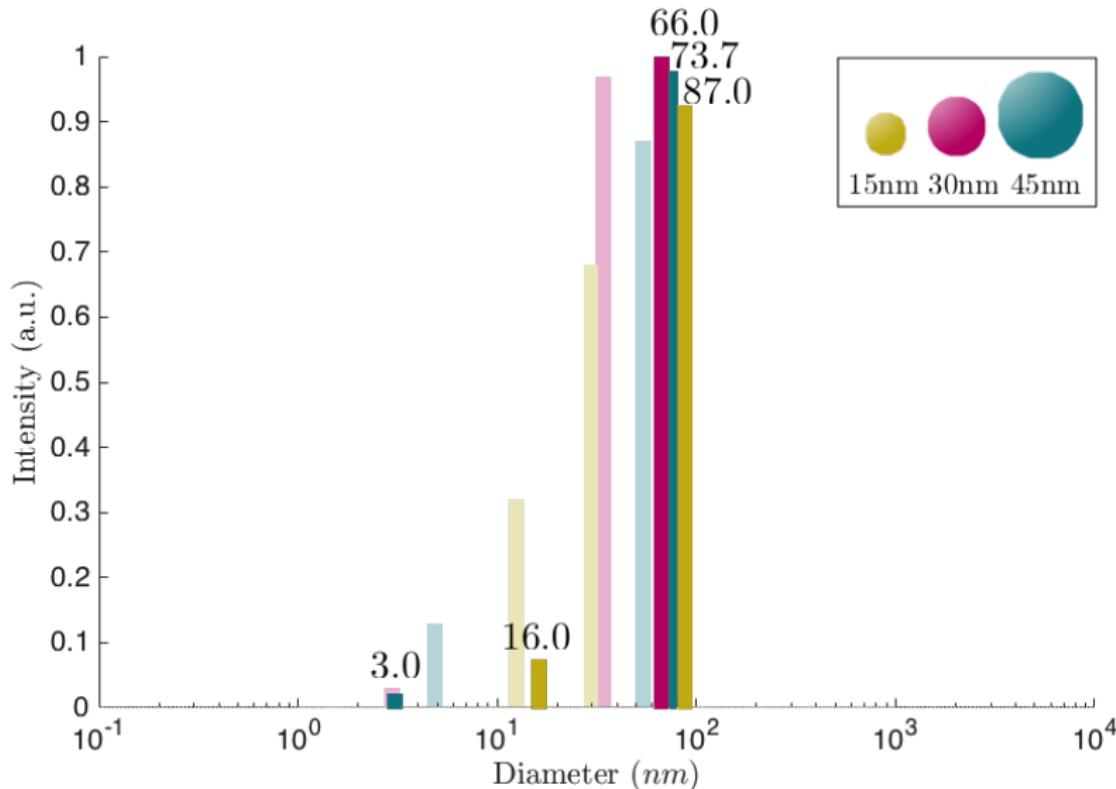
Results

Functionalisation no PEG



Results

Functionalisation 20k PEG



Results

Functionalization 15nm 20k PEG

Proportion (PEG/GNP)	Average
5/10	51.93 ± 2.76
6/10	80.89 ± 14.64
7/10	65.24 ± 14.32
8/10	83.91 ± 18.42
9/10	

Original functionalization 20k (8/10)



Results

Functionalization 15nm 20k PEG

Proportion (PEG/GNP)	Average	Average (centrifuge)
5/10	51.93 ± 2.76	68.70 ± 7.99
6/10	80.89 ± 14.64	65.16 ± 11.61
7/10	65.24 ± 14.32	57.73 ± 7.72
8/10	83.91 ± 18.42	72.36 ± 10.44
9/10		56.54 ± 3.91

Original functionalization 20k (8/10)



Conclusion

- Synthesis of GNP
- Characterization
- Stabilization with neutral PEG
- Stabilization with positively charged PEG
- X-Rays
- Analyze effect on DNA
- Solve problem with DLS

