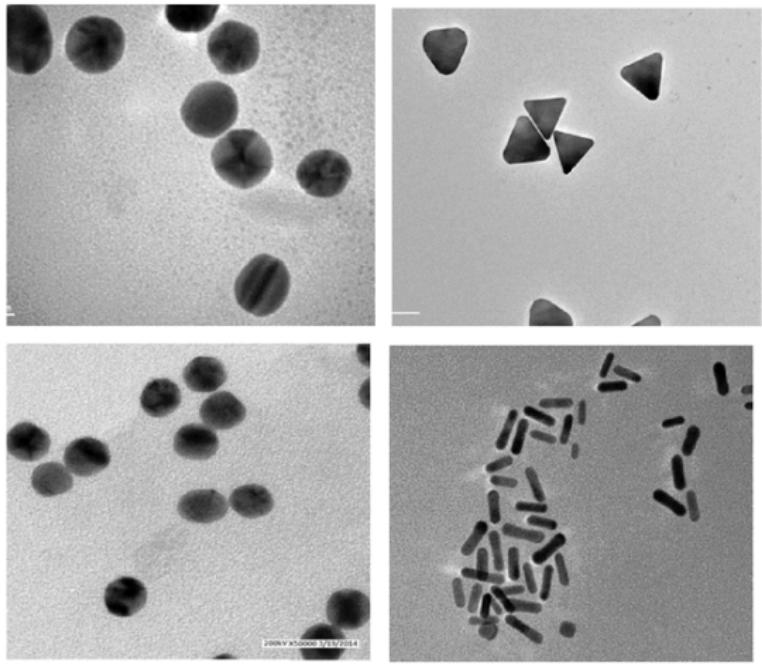


Bachelor Thesis 2016
As. Bert De Roo, Matthias
Vervaele, Stephanie Seré

Radiosensitization using gold nanoparticles

25th March

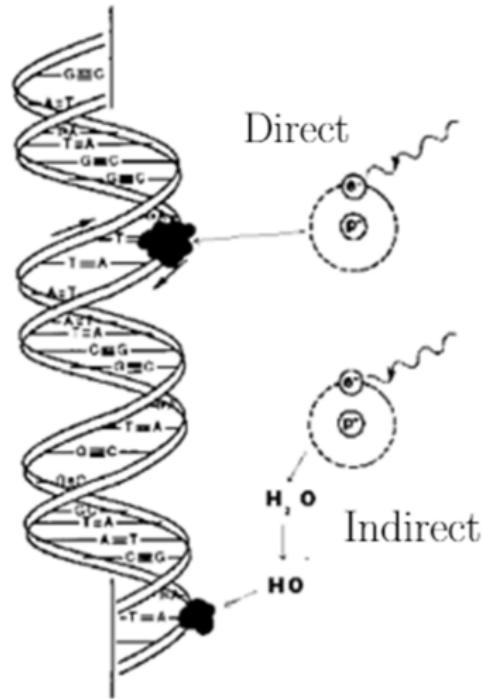
Introduction
Synthesis GNP
Chemical protocol
Size GNP
Stabilization
Characterization



Cancer treatment

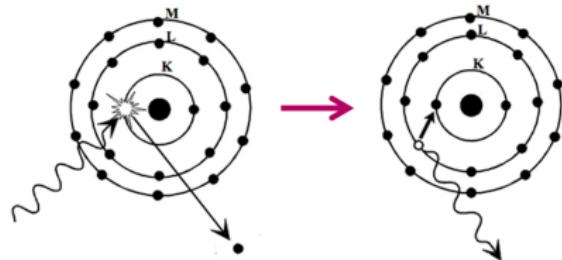
- Chemotherapy
- Surgery
- **Radiation therapy**

Energy $\sim MeV$

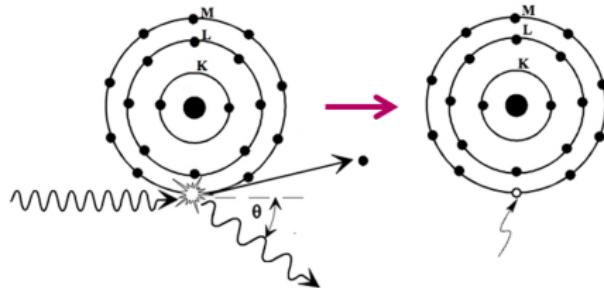


Radiosensitization with GNP $E \sim \text{keV}$

Photoelectric absorption



Compton effect

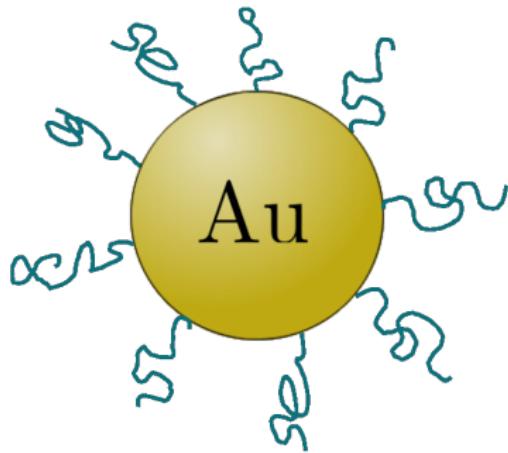


Why gold?

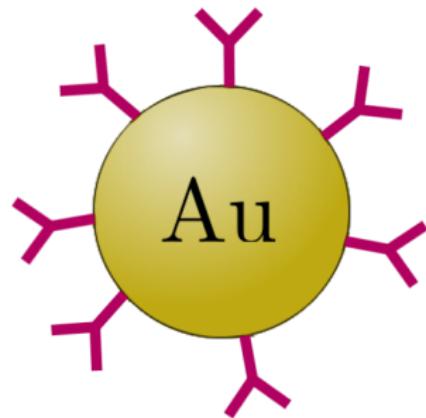
- High atomic number (79)
- Low toxicity

Targeting

Passive targeting
PEG coating

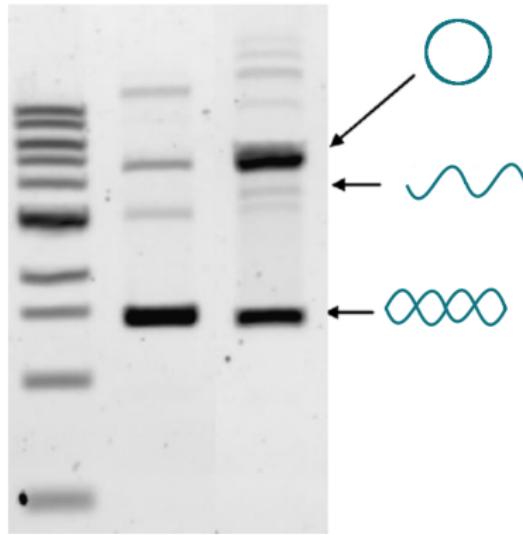


Active targeting
Antibodies



Goal

1. Synthesis
2. Characterization
3. Radiosensitization



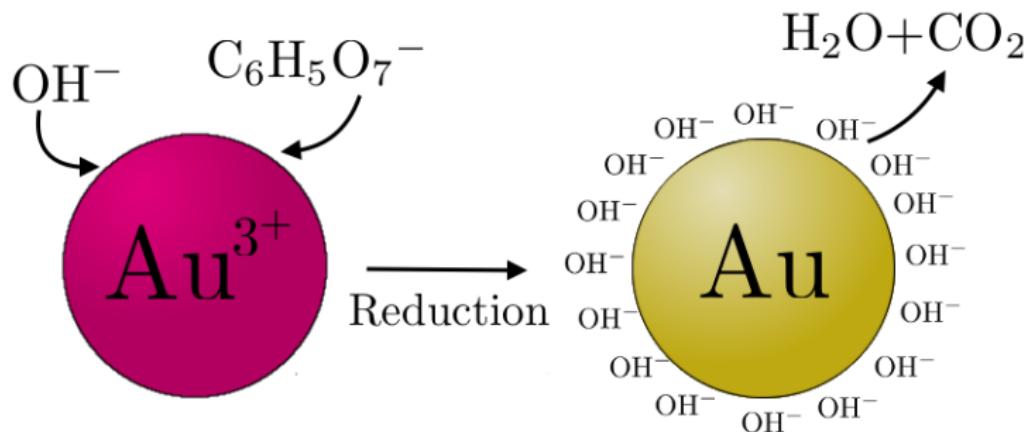
Chemical protocol



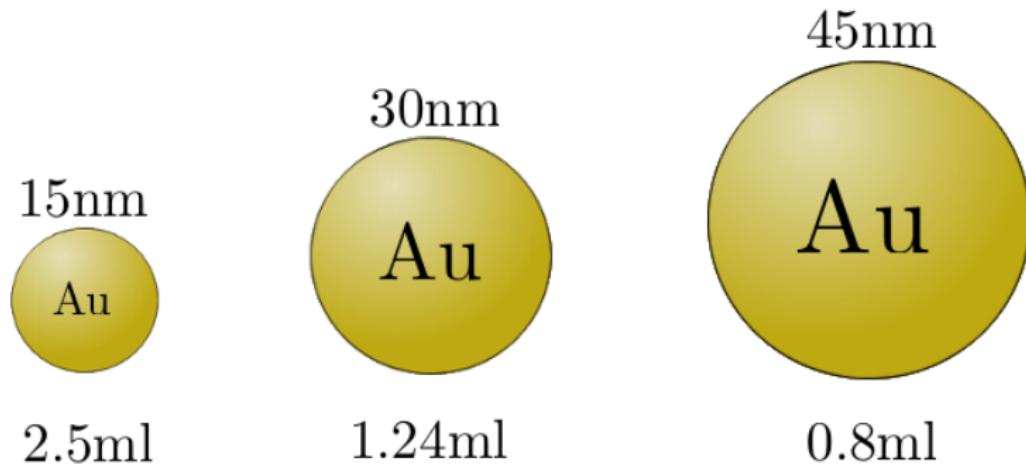
Gold ions: HAuCl₄ solution

Reducing agent: Na₃C₆H₅O₇

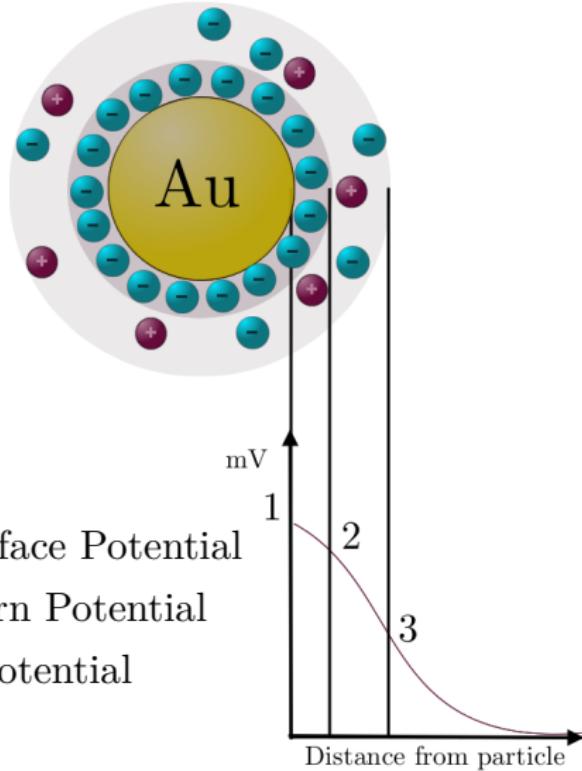
Chemical protocol



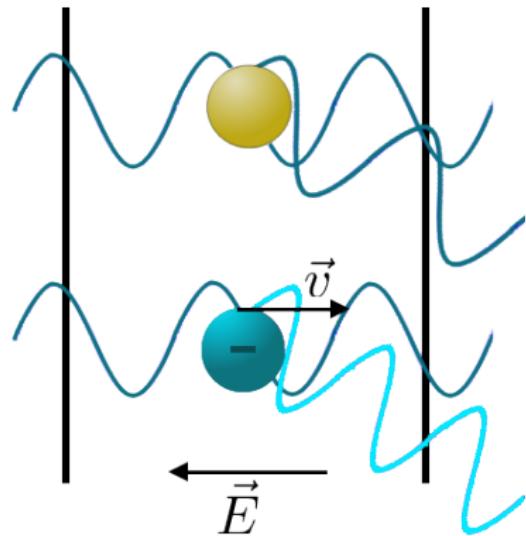
Size GNP



Zeta Potential

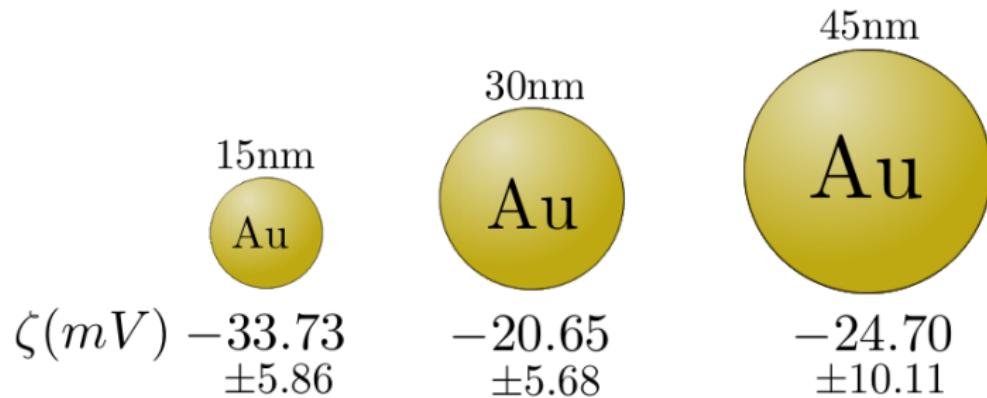


Laser Doppler Gel electrophoresis

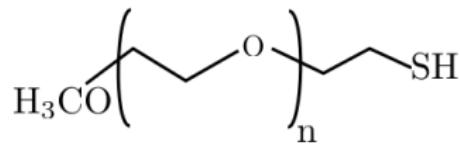
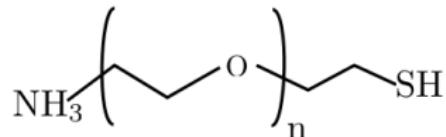
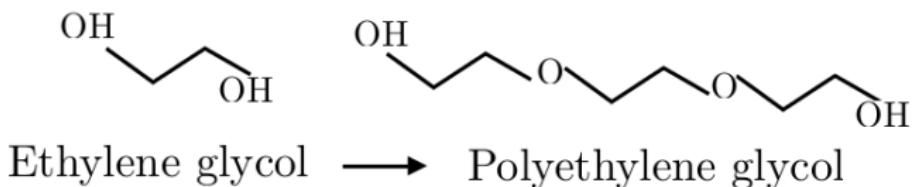


$$\zeta = \frac{2\eta v}{3E\epsilon} \quad |\zeta| \geq 30\text{mV}$$

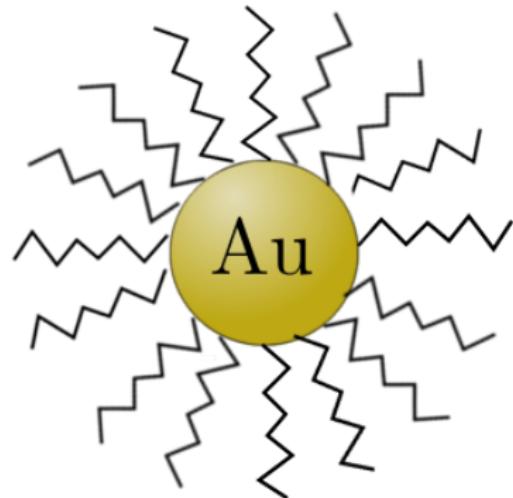
Zeta Potential: Results



Functionalization PEG

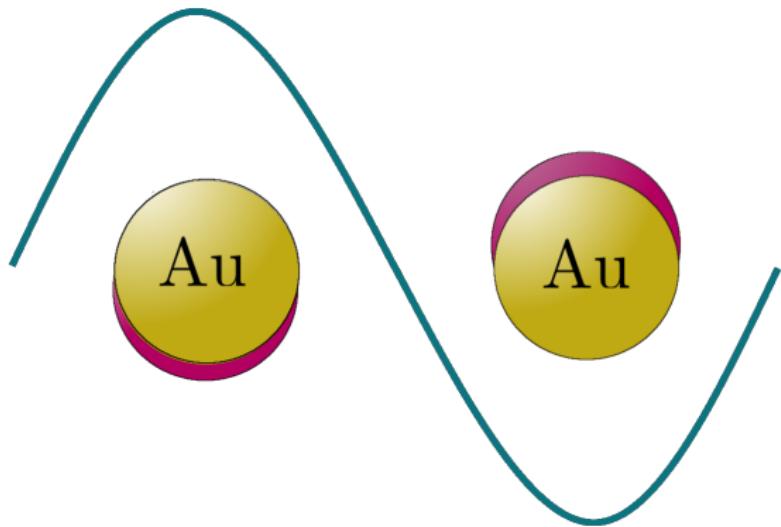


20k, 10k, 5k, 1k



UV-Vis spectroscopy

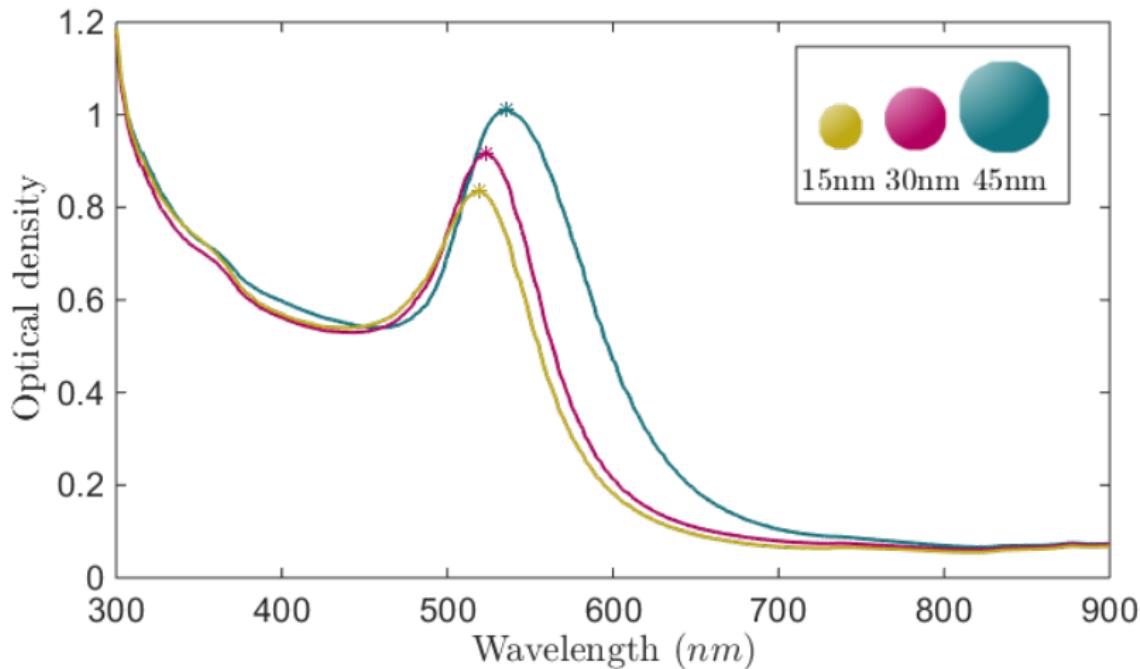
1. Add PEG
2. Size GNP
3. Add NaCl
4. Size GNP



bigger size → too little PEG
same size → enough PEG

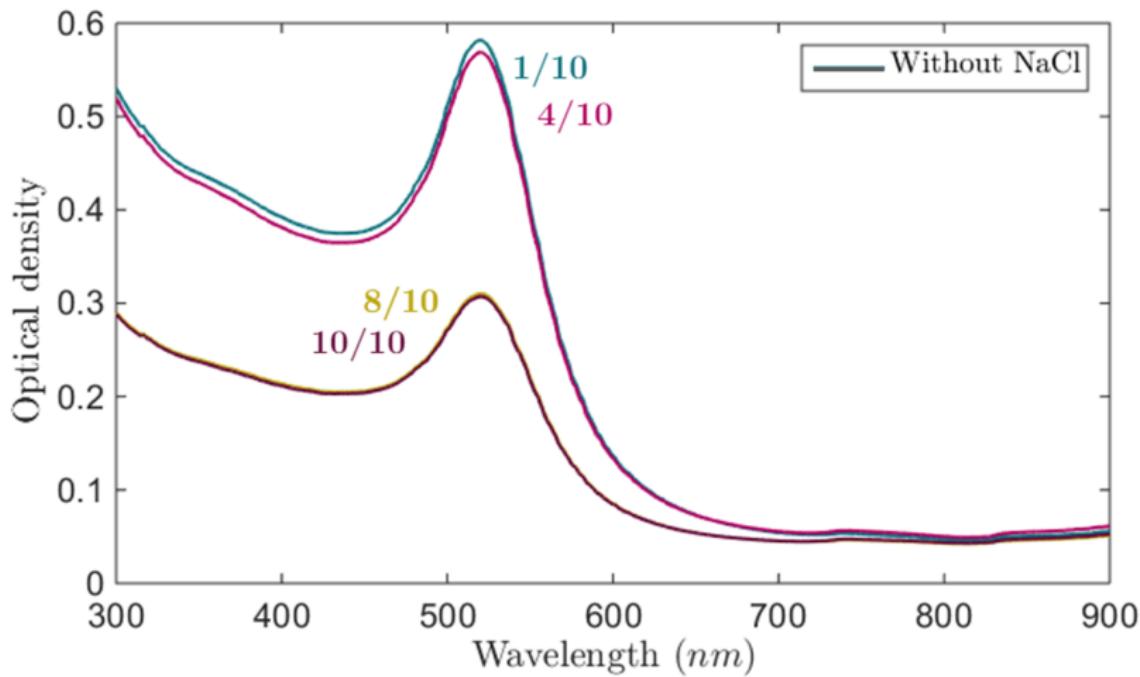
Results

GNP no PEG



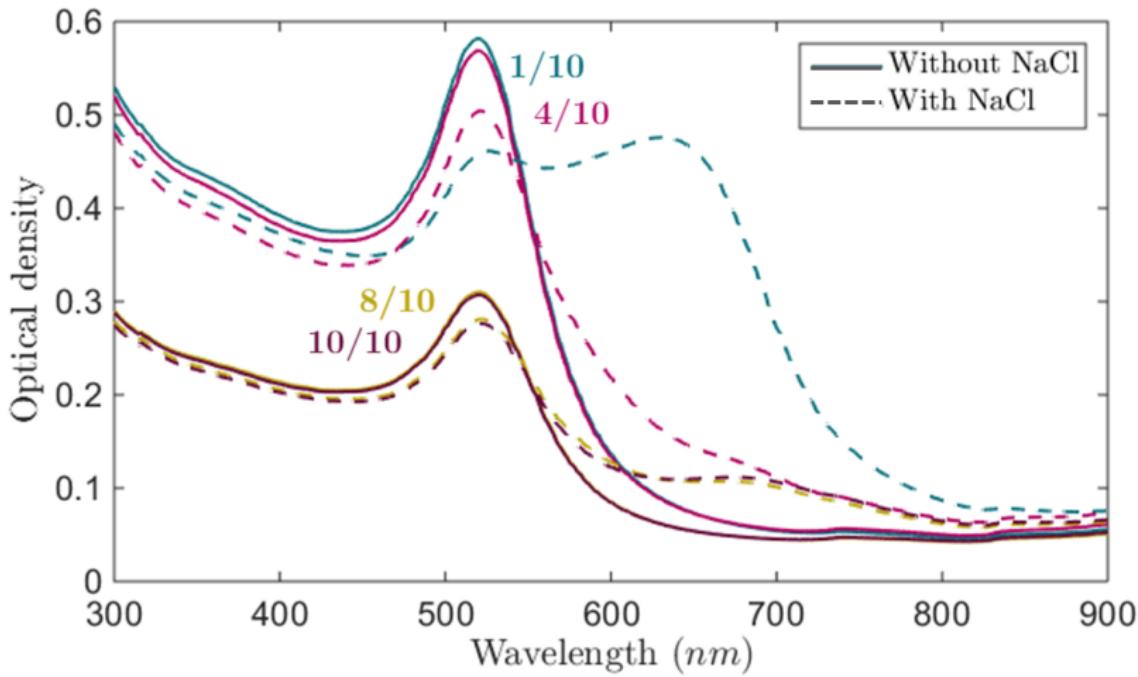
Results

15nm GNP 20k PEG for different PEG/GNP



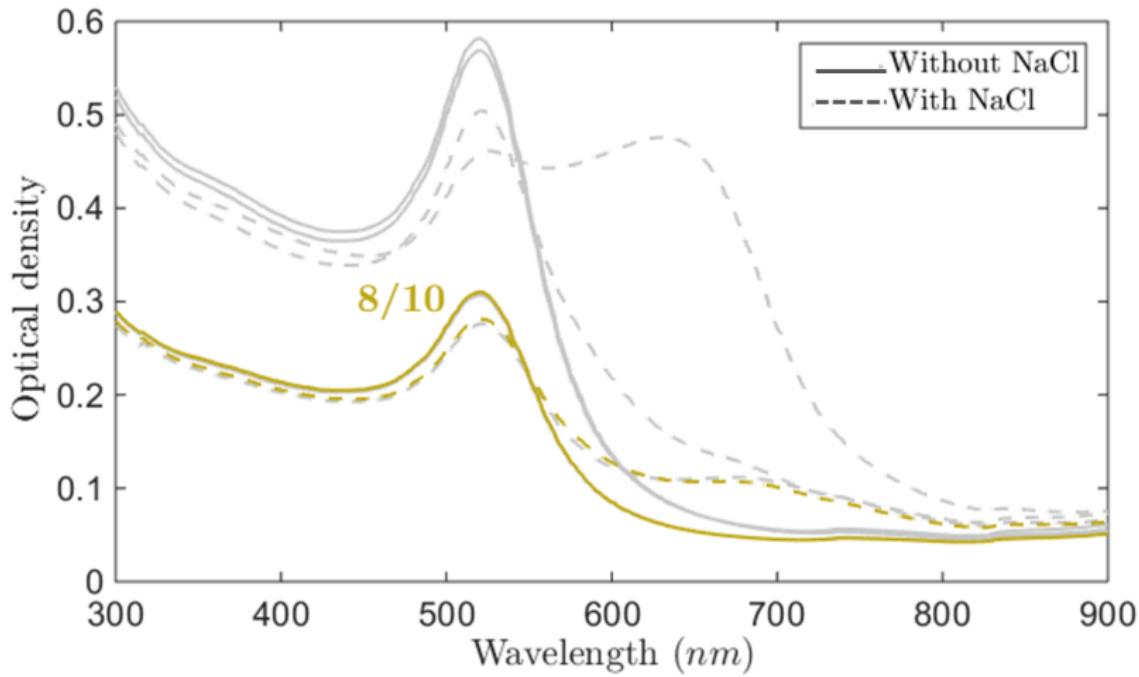
Results

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

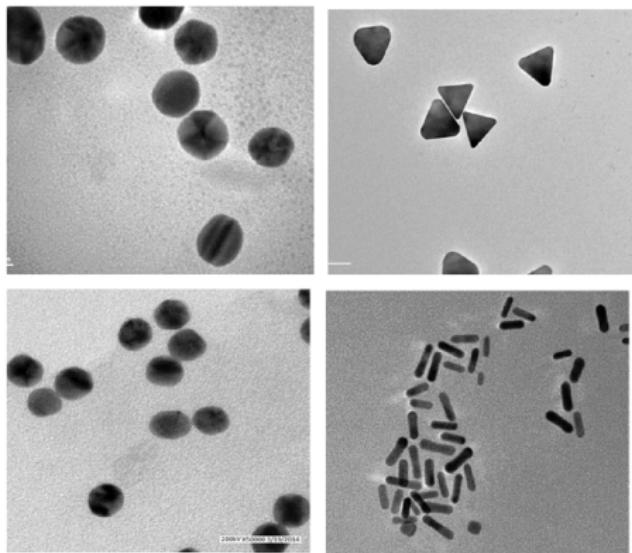
Chemical Protocol

UV-VIS

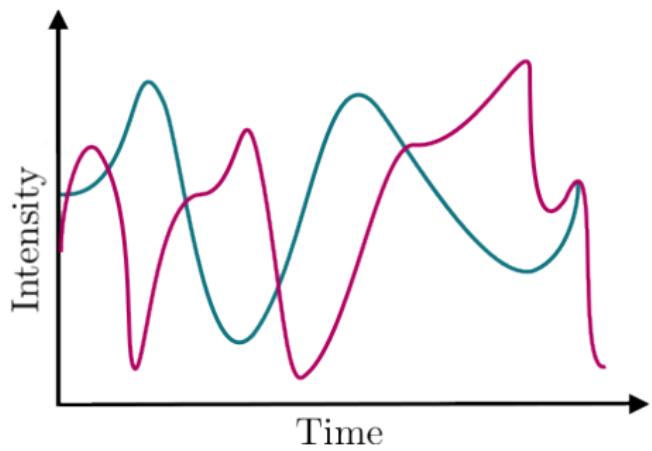
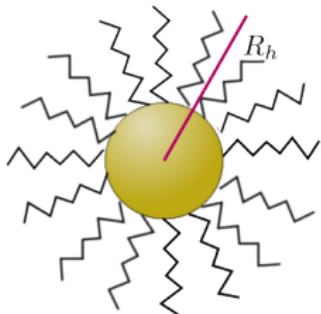
TEM

Hydrodynamic Radius

DLS

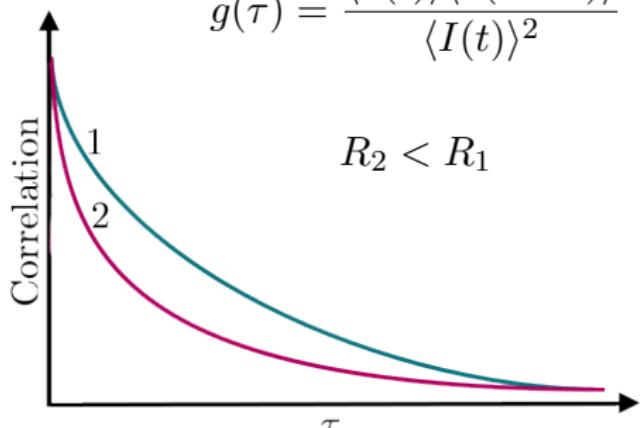


Dynamic light scattering (DLS)



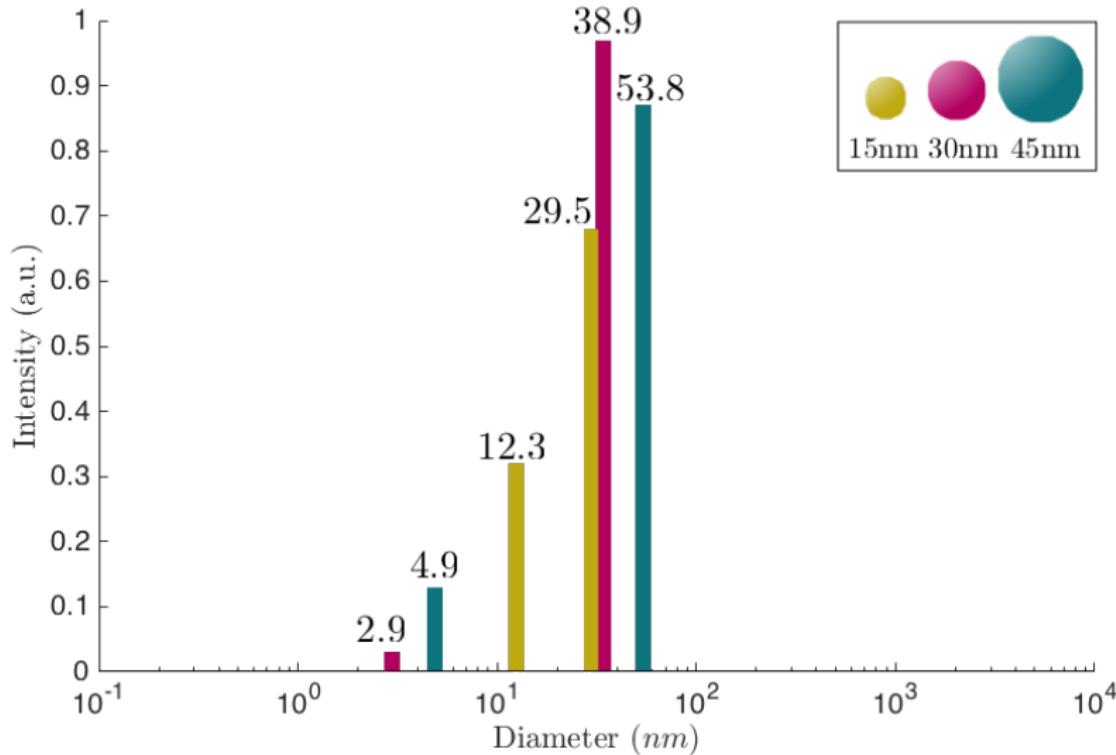
Hydrodynamic radius (R_h)
 → Rayleigh scattering

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



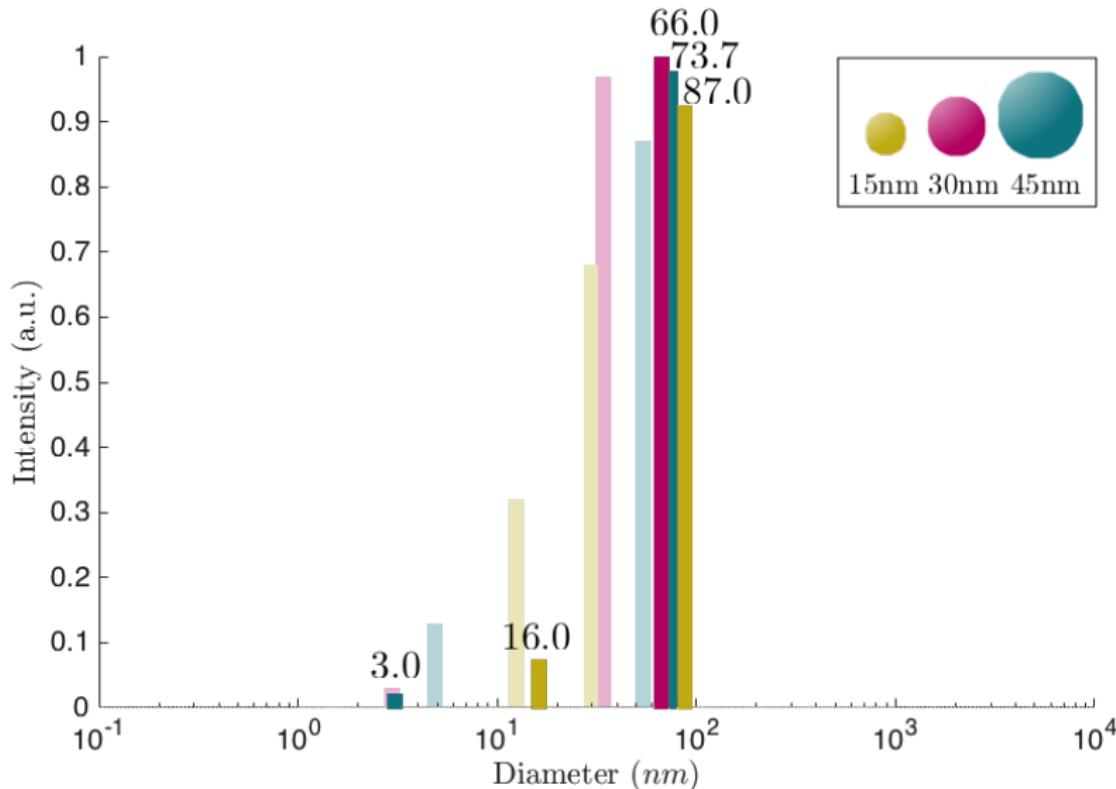
Results

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)

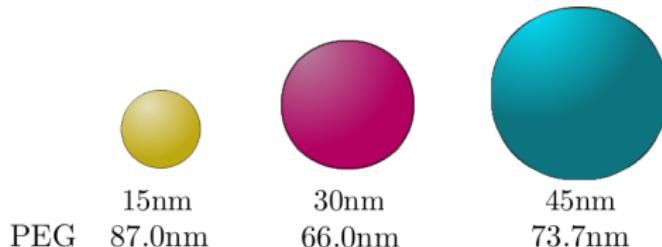


Results

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

