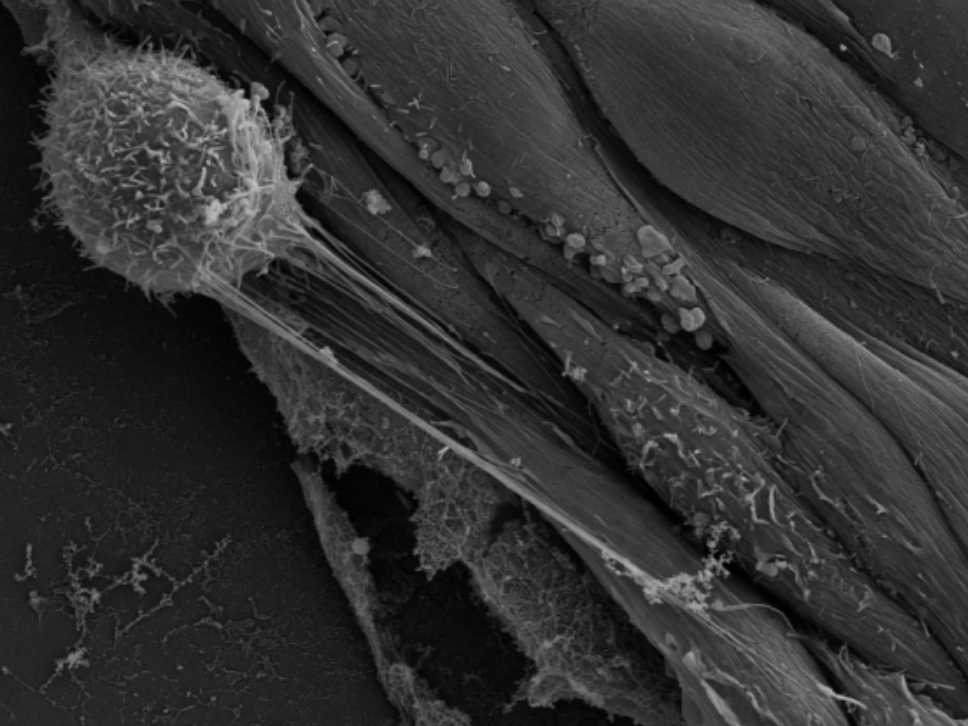


Bachelor Thesis 2016

Radiosensitization using gold nanoparticles

Lies Deceuninck en Hannelore Verhoeven

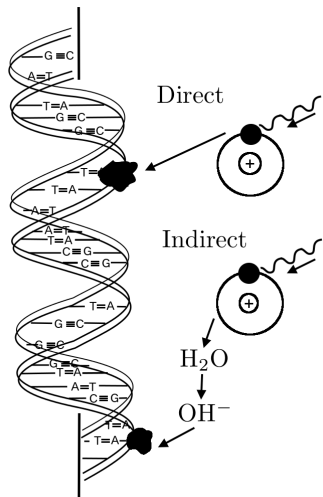
Assistents: Bert De Roo
Mattias Vervaele
Professor: Chris Van Haesendonck



DNA damage using ionizing radiation

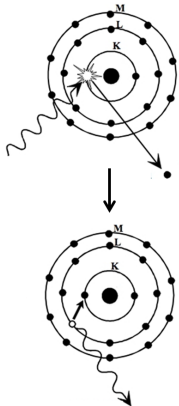
- Chemotherapy
- Surgery
- **Radiation therapy**

Energy \sim MeV

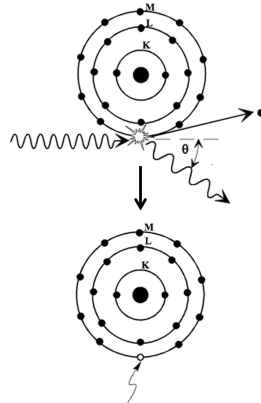


Radiosensitization of cancer cells with gold nanoparticles (GNP) $E \sim \text{keV}$

Photoelectric absorption



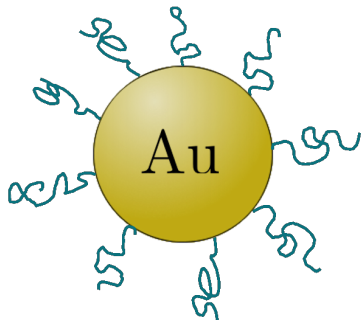
Compton effect



Targeting of the GNP to the tumor

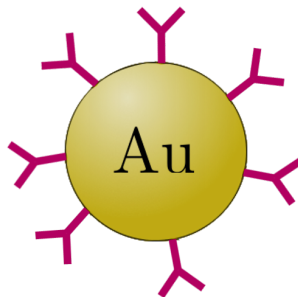
Passive targeting

PEG coating



Active targeting

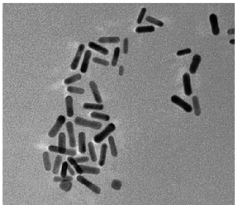
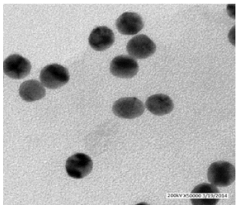
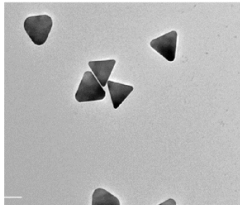
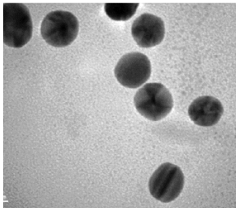
Antibodies



Overview Project

Radiosensitization of cancer cells using gold nanoparticles

1. Synthesis
2. Characterization
3. Radiosensitization



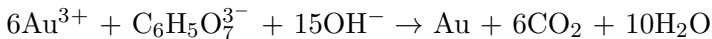
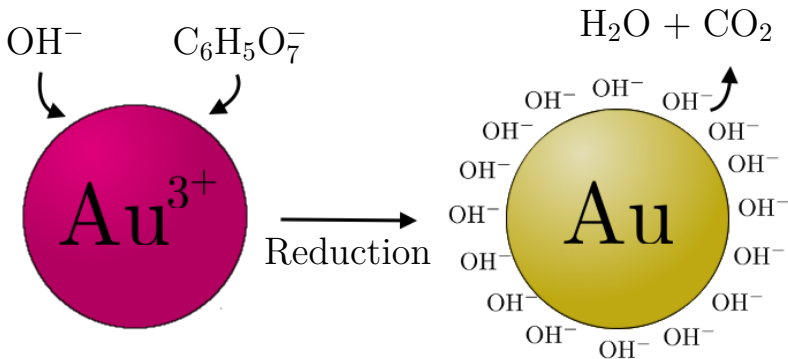
Reduction of gold ions to form GNP



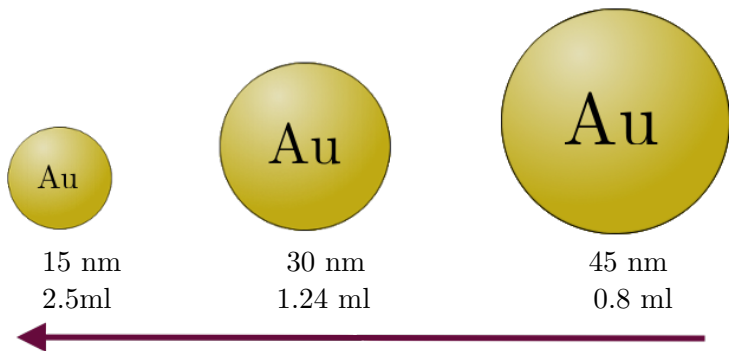
Gold ions: HAuCl_4 solution

Reducing agent: $\text{Na}_3\text{C}_6\text{H}_5\text{O}_7$

Reduction of gold ions to form GNP

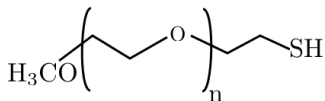
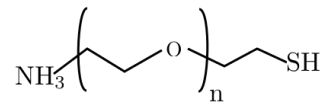
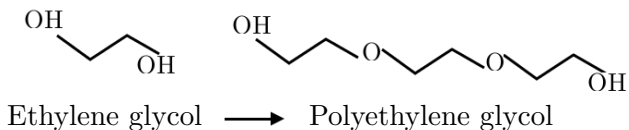


The amount of citrate controls the size

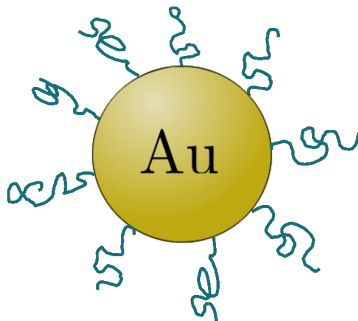


Citrate 1%
100ml HAuCl₄ 0.01%

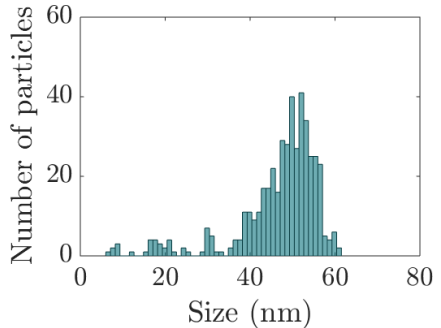
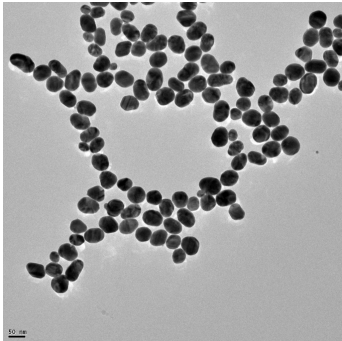
PEG for targeting and stabilization



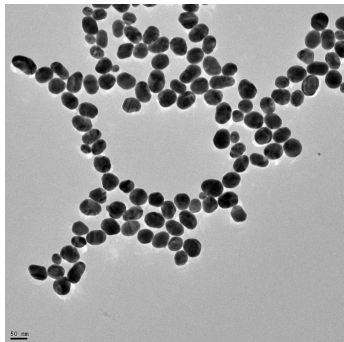
1k, 5k, 10k, 20k



TEM image analysis to determine the core diameter



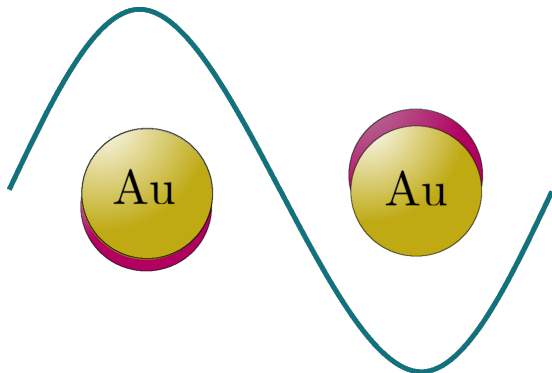
TEM image analysis to determine the core diameter



Exp. Size (nm)	Size (nm)
15	12.98 ± 0.23
	2.99 ± 0.16
30	18.29 ± 0.23
45	46.75 ± 0.47

UV-Vis spectroscopy

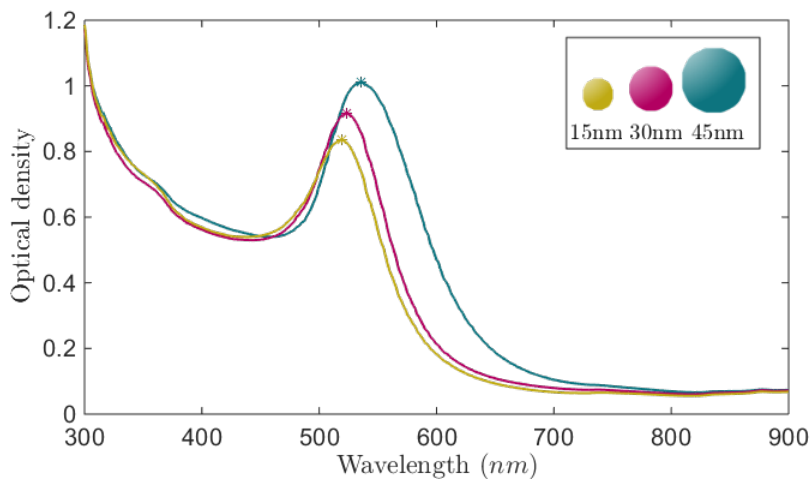
1. Add PEG
2. Size GNP
3. Add NaCl
4. Size GNP



bigger size \rightarrow too little PEG
same size \rightarrow enough PEG

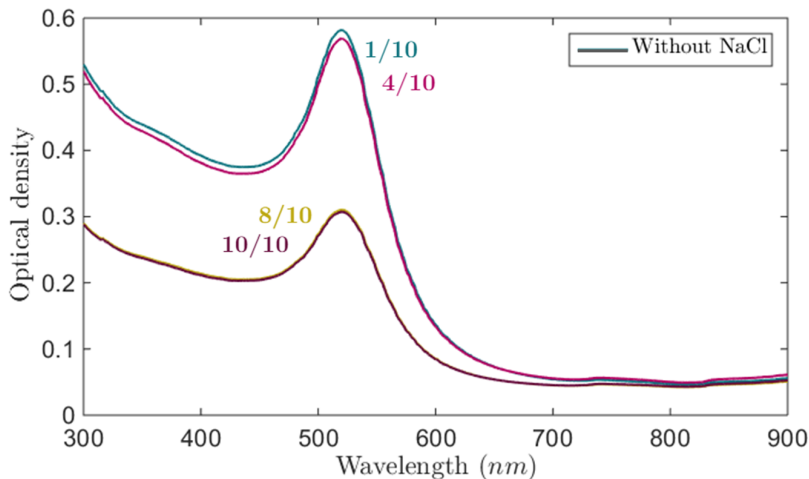
Results

GNP no PEG



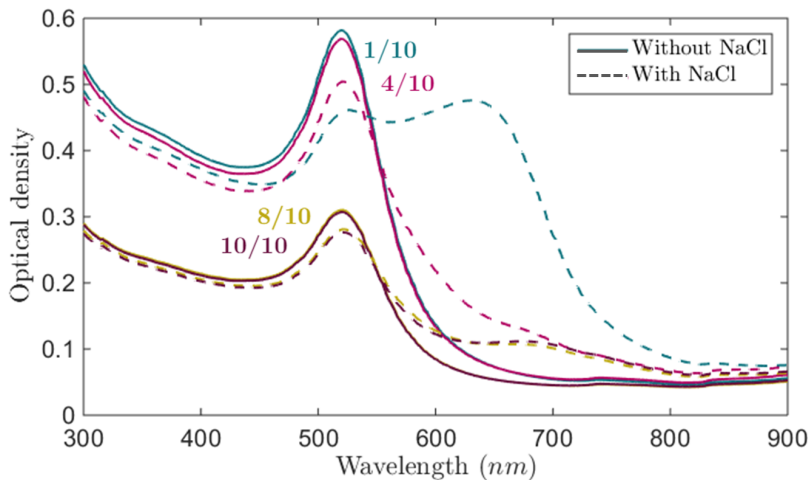
Results

15nm GNP 20k PEG for different PEG/GNP



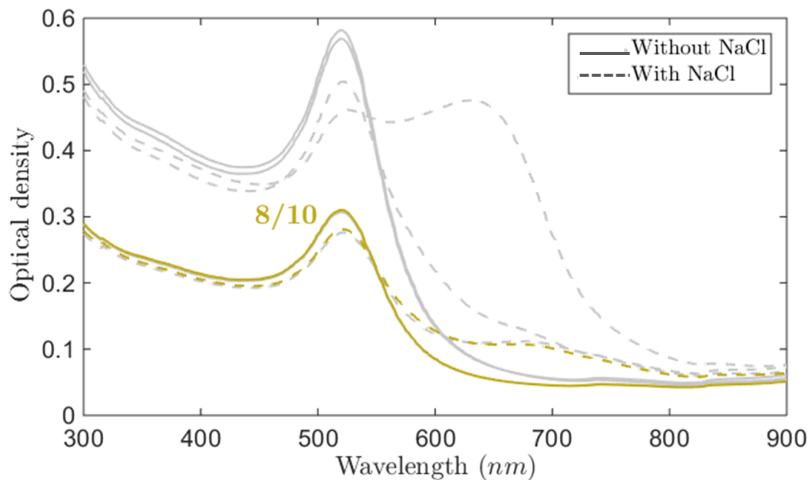
Results

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

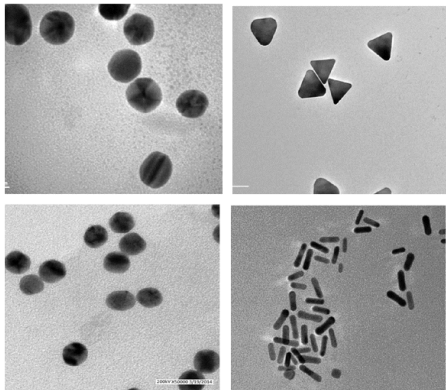
Chemical Protocol

UV-VIS

TEM

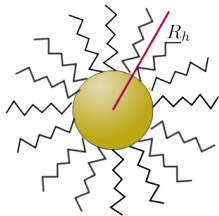
Hydrodynamic Radius

DLS



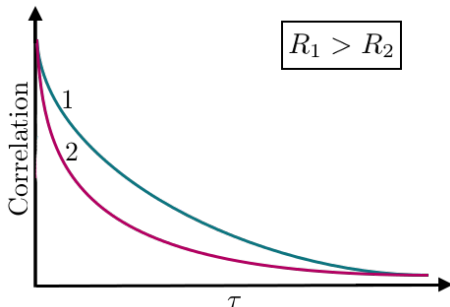
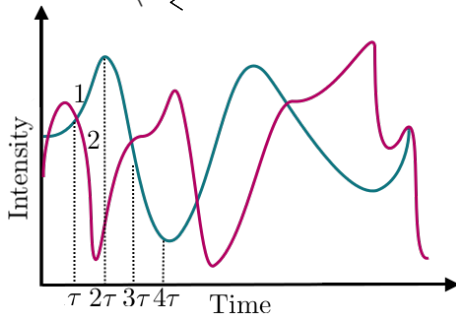
Light scattering experiments to determine the hydrodynamic radius (R_h)

Important for diffusive properties

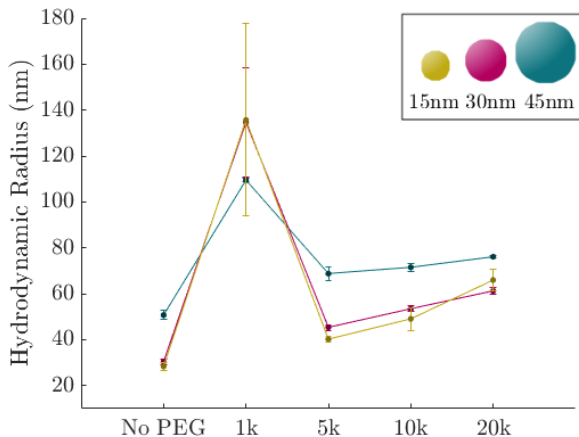


Correlation:

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



Hydrodynamic radii for the three different GNP with different functionalizations



Conclusion

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

