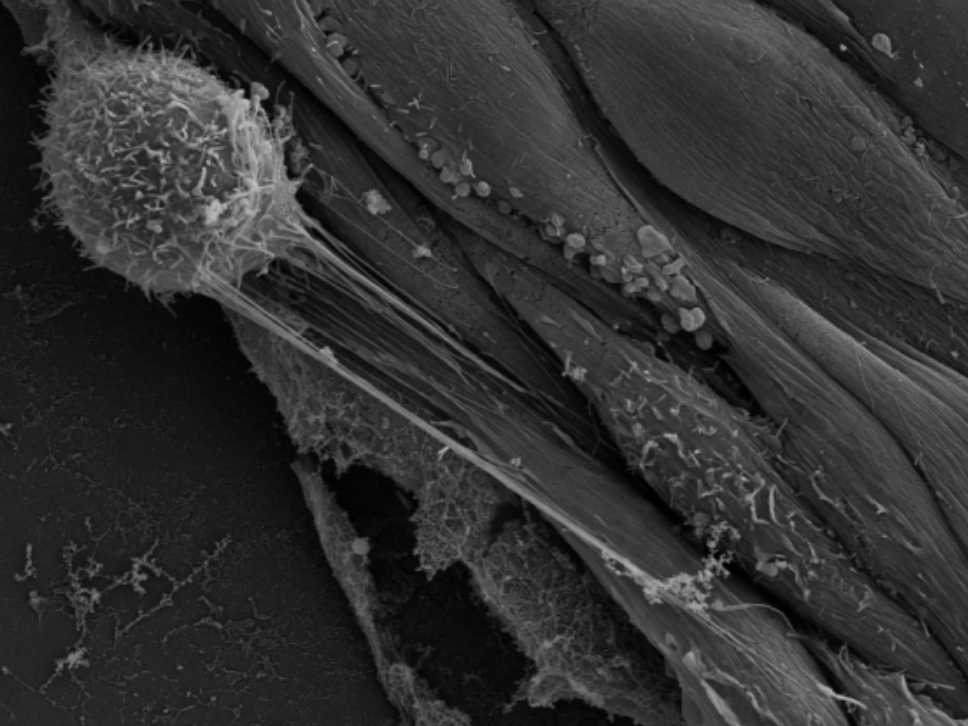


Bachelor Thesis 2016

Radiosensitization using gold nanoparticles

Lies Deceuninck en Hannelore Verhoeven

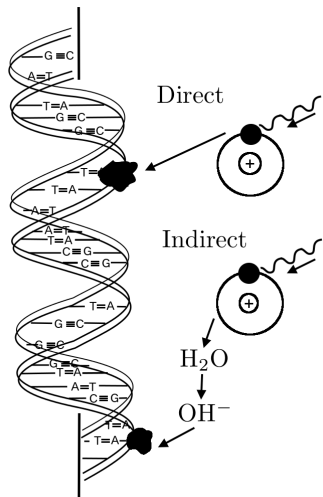
Assistents: Bert De Roo
Mattias Vervaele
Professor: Chris Van Haesendonck



DNA damage using ionizing radiation

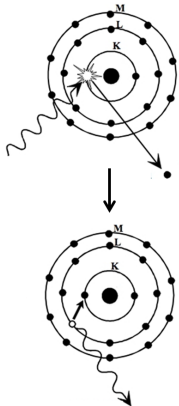
- Chemotherapy
- Surgery
- **Radiation therapy**

Energy \sim MeV

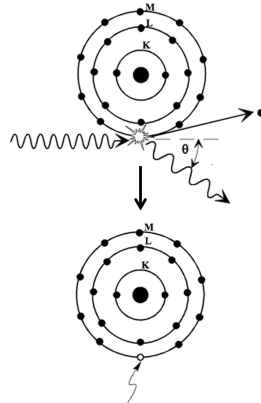


Radiosensitization of cancer cells with gold nanoparticles (GNP) $E \sim \text{keV}$

Photoelectric absorption



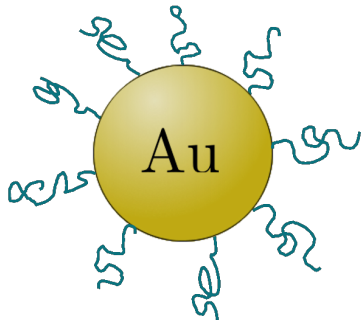
Compton effect



Targeting of the GNP to the tumor

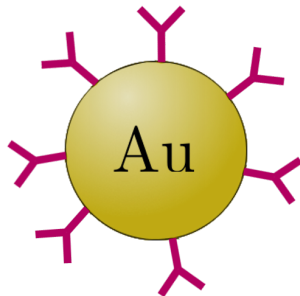
Passive targeting

PEG coating



Active targeting

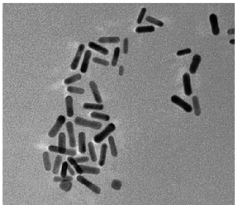
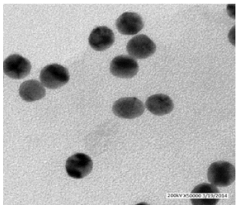
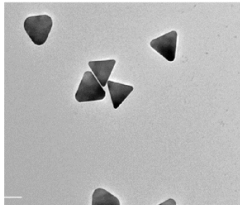
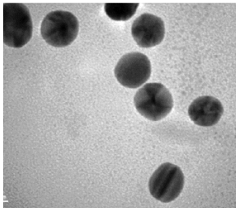
Antibodies



Overview Project

Radiosensitization of cancer cells using gold nanoparticles

1. Synthesis
2. Characterization
3. Radiosensitization



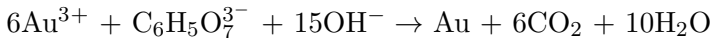
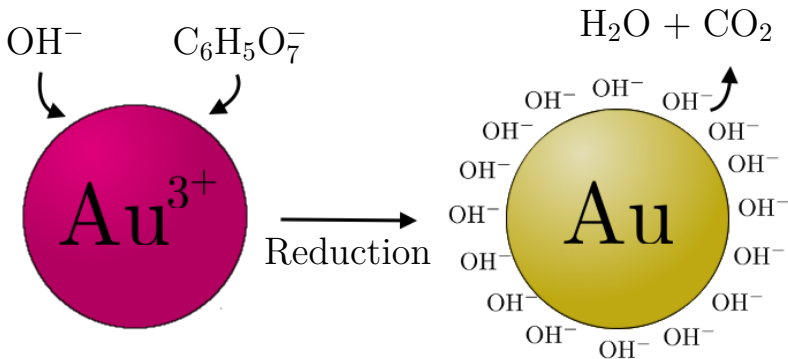
Reduction of gold ions to form GNP



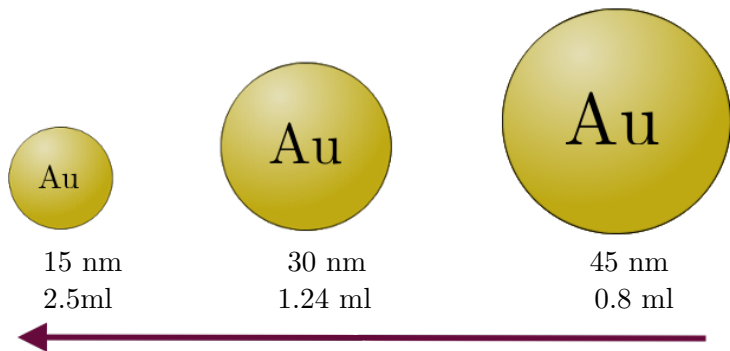
Gold ions: HAuCl_4 solution

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

Reduction of gold ions to form GNP

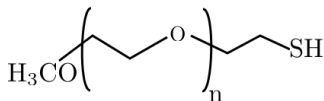
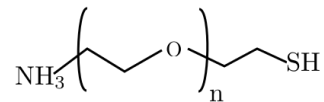
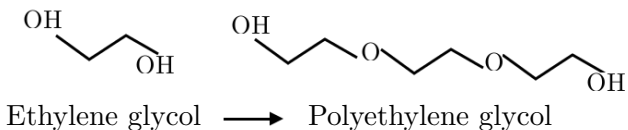


The amount of citrate controls the size

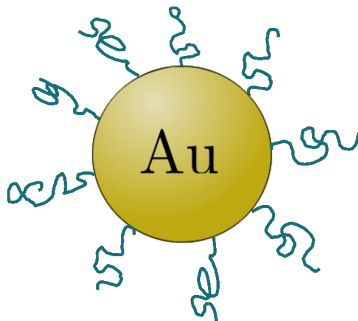


Citrate 1%
100ml HAuCl₄ 0.01%

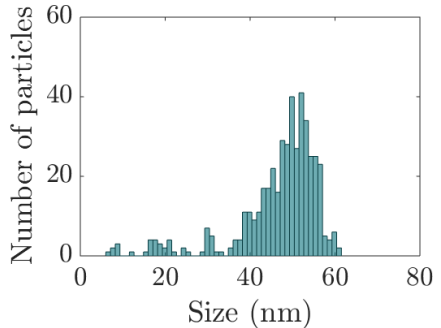
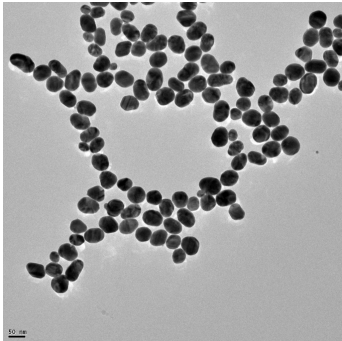
PEG for targeting and stabilization



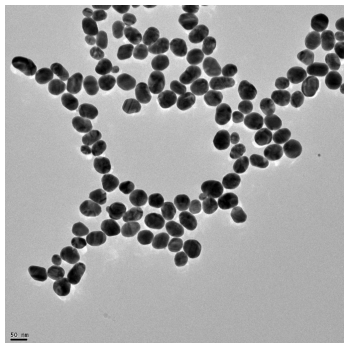
1k, 5k, 10k, 20k



TEM image analysis to determine the core diameter

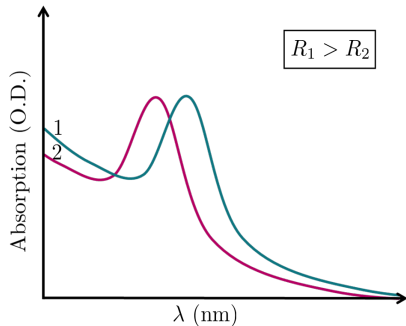
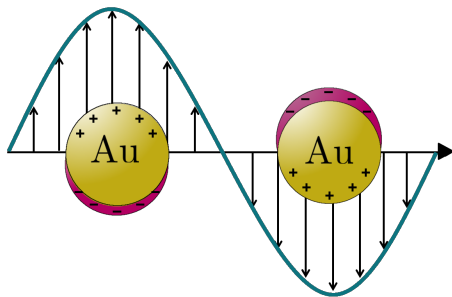


TEM image analysis to determine the core diameter

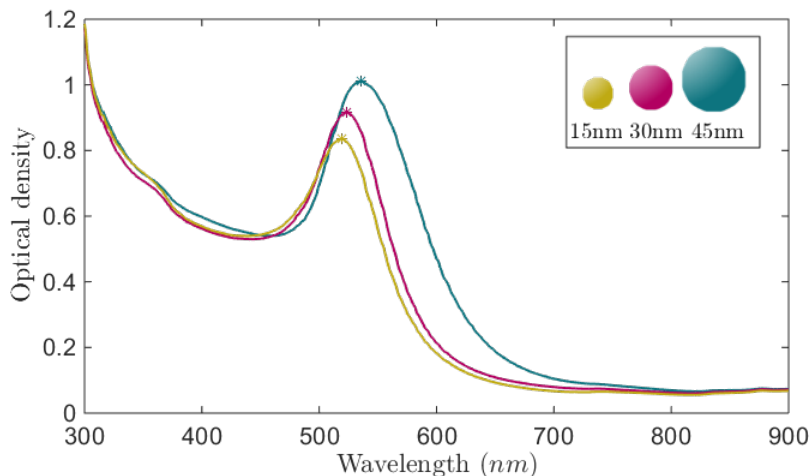


Exp. Size (nm)	Size (nm)
15	12.98 ± 0.23
	2.99 ± 0.16
30	18.29 ± 0.23
45	46.75 ± 0.47

Absorption measurements (UV-Vis) to determine the relative size

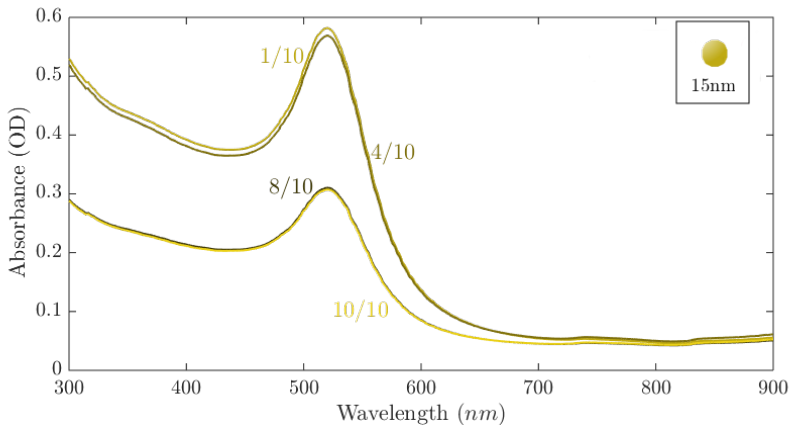


Absorption measurements (UV-Vis) to determine the relative size



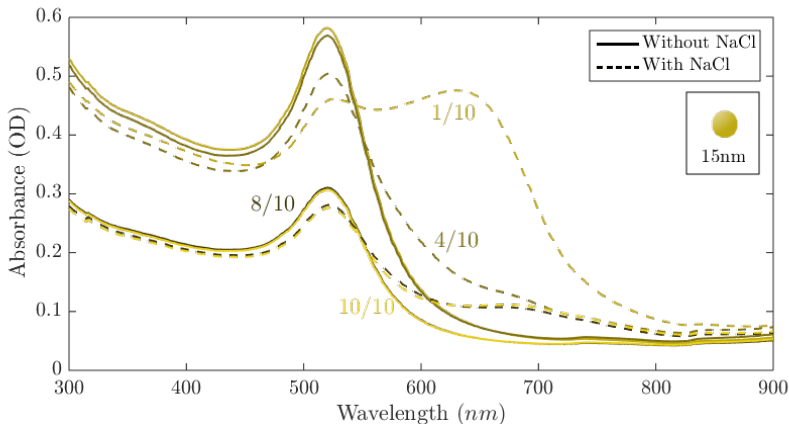
Absorption measurements (UV-Vis) to determine the optimal PEG proportion

1. Add PEG and preform UV-Vis measurement



Absorption measurements (UV-Vis) to determine the optimal PEG proportion

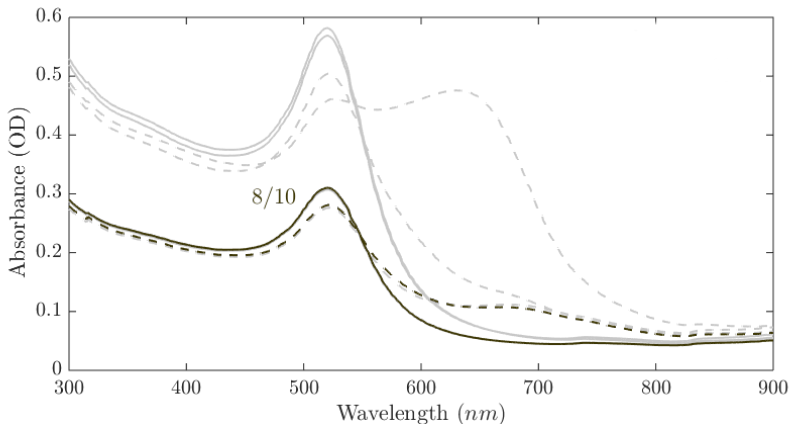
2. Add NaCl and perform UV-Vis measurement



Absorption measurements (UV-Vis) to determine the optimal PEG proportion

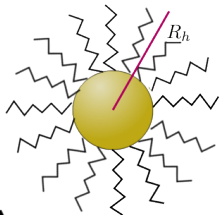
bigger size \rightarrow too little PEG

same size \rightarrow enough PEG



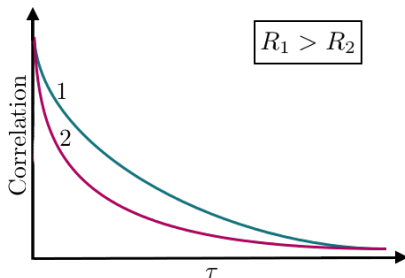
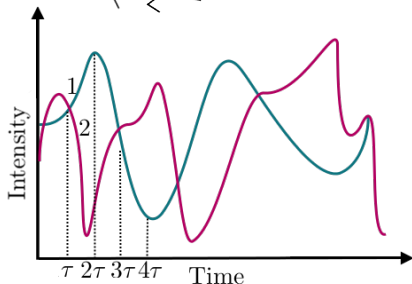
Light scattering experiments to determine the hydrodynamic radius (R_h)

Important for diffusive properties

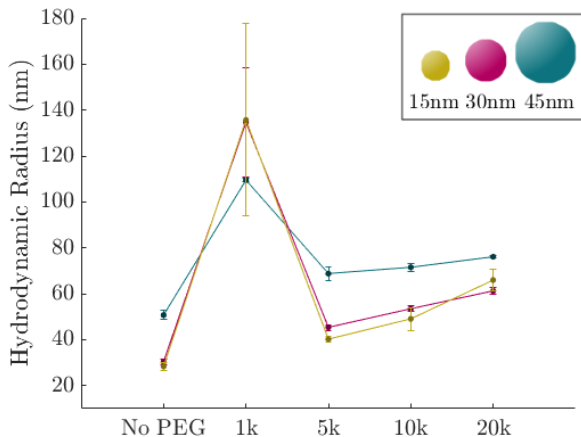


Correlation:

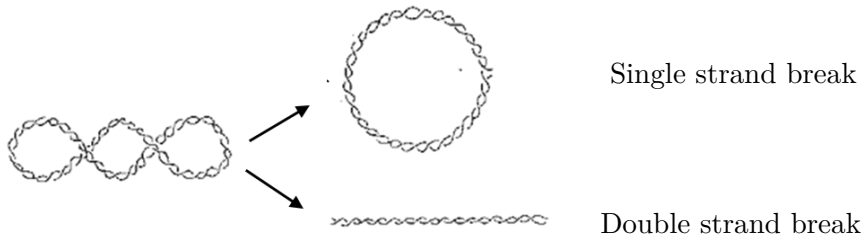
$$g(\tau) = \frac{\langle I(t) \rangle \langle I(t+\tau) \rangle}{\langle I(t) \rangle^2}$$



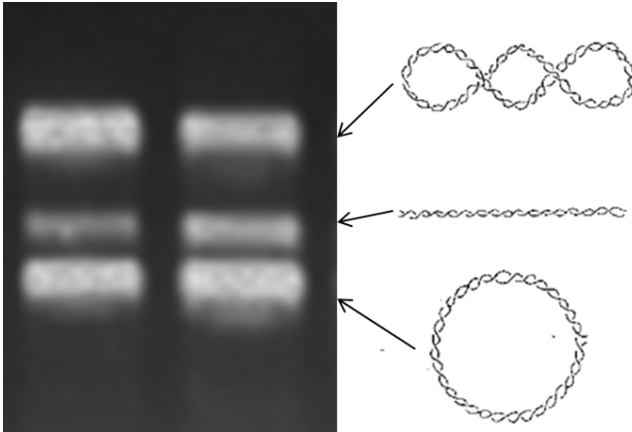
Hydrodynamic radii for the three different GNP with different functionalizations



Gel electrophoresis to analyse DNA damage



Gel electrophoresis to analyse DNA damage



Conclusion

- Functionalization 1k strange behavior
- Best results with...
 - ...5k functionalization
 - ...largest particles (45 nm)

⇒ Radiosensitization effect observed

