

Bachelor Thesis 2016

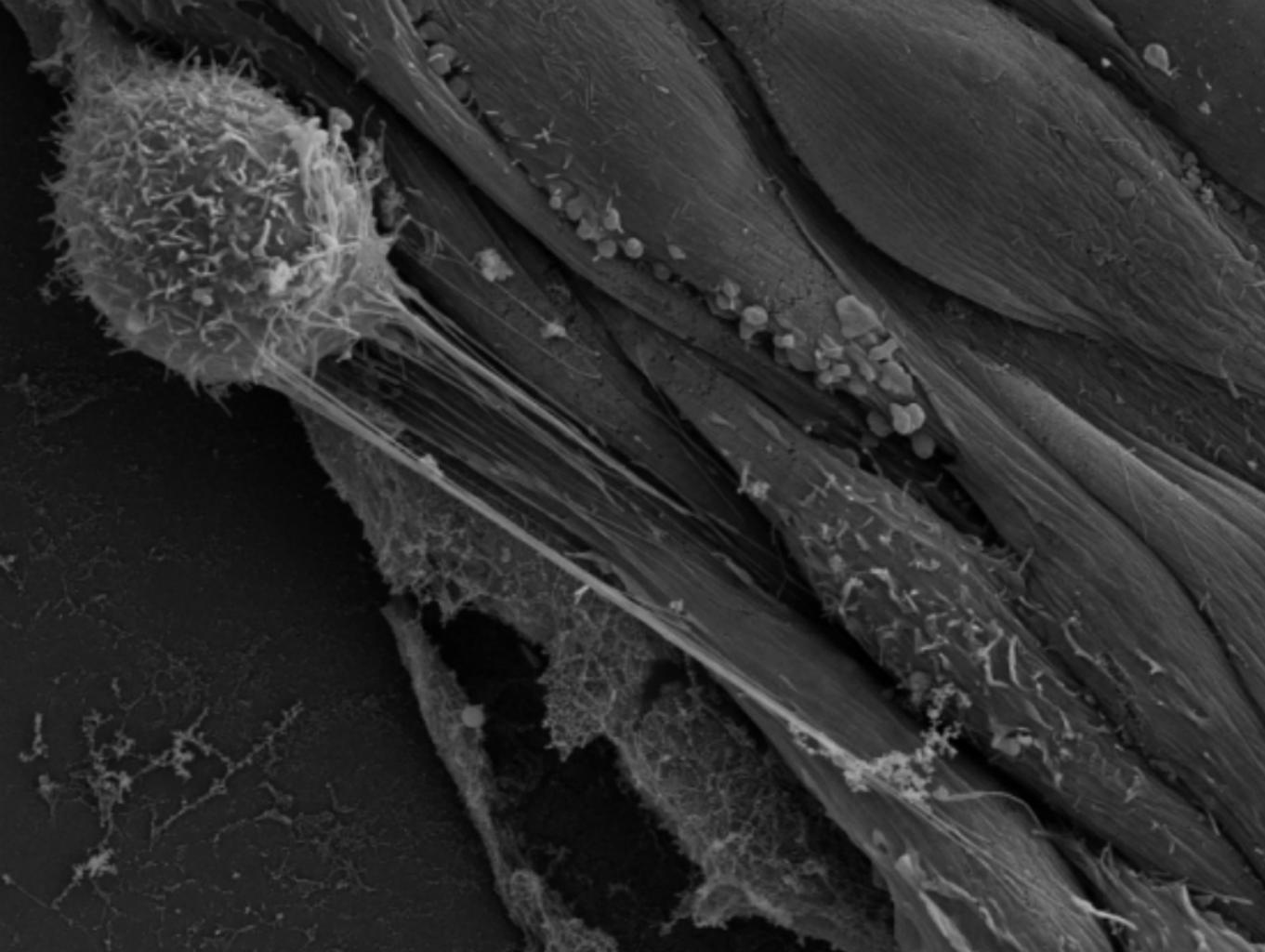
Radiosensitization using gold nanoparticles

Lies Deceuninck en Hannelore Verhoeven

Assistents: Bert De Roo

Mattias Vervaele

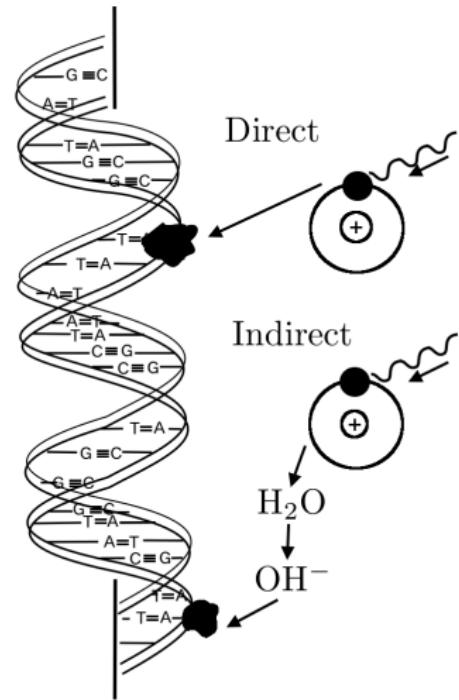
Professor: Chris Van Haesendonck



DNA damage using ionizing radiation

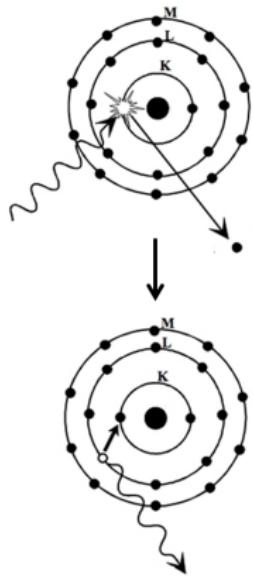
- Chemotherapy
- Surgery
- **Radiation therapy**

Energy \sim MeV

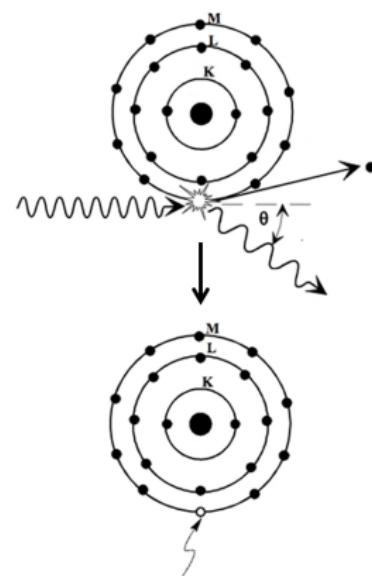


Radiosensitization of cancer cells with gold nanoparticles (GNP) $E \sim \text{keV}$

Photoelectric absorption

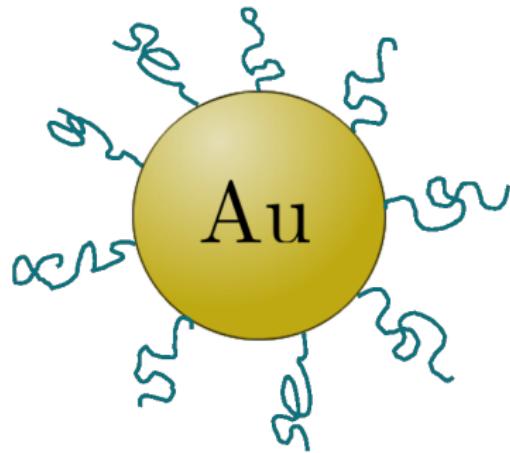


Compton effect

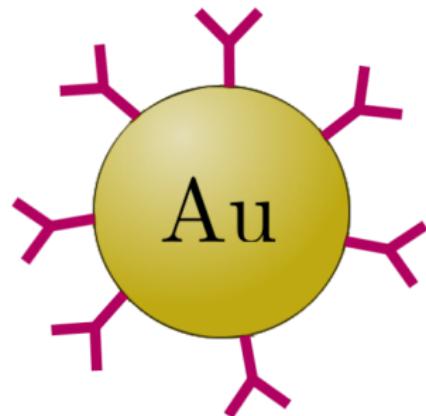


Targeting of the GNP to the tumor

Passive targeting
PEG coating



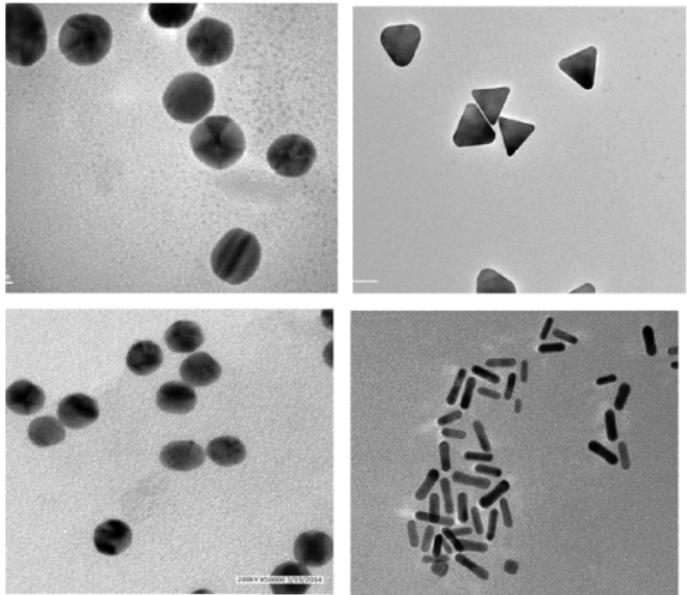
Active targeting
Antibodies



Overview Project

Radiosensitization of cancer cells
using gold nanoparticles

1. Synthesis
2. Characterization
3. Radiosensitization



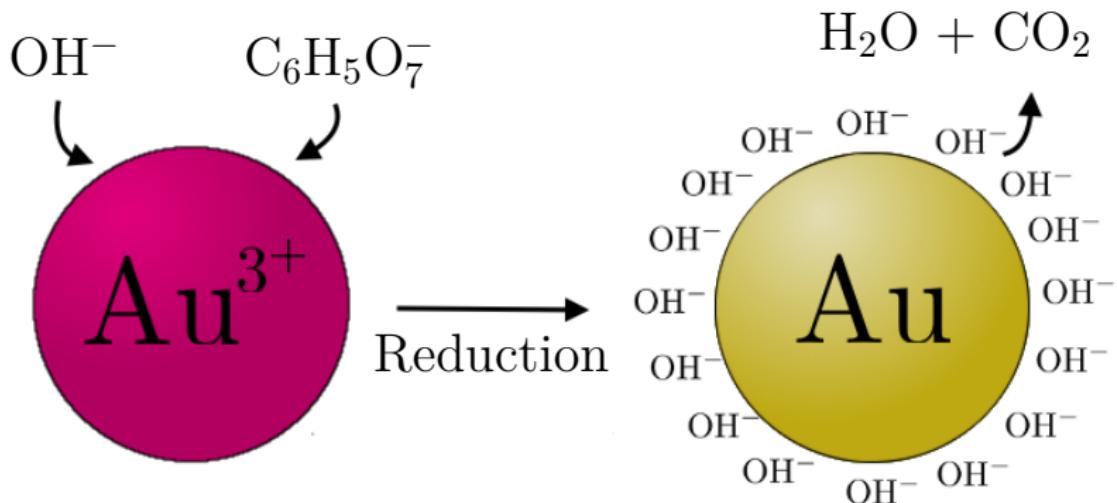
Reduction of gold ions to form GNP



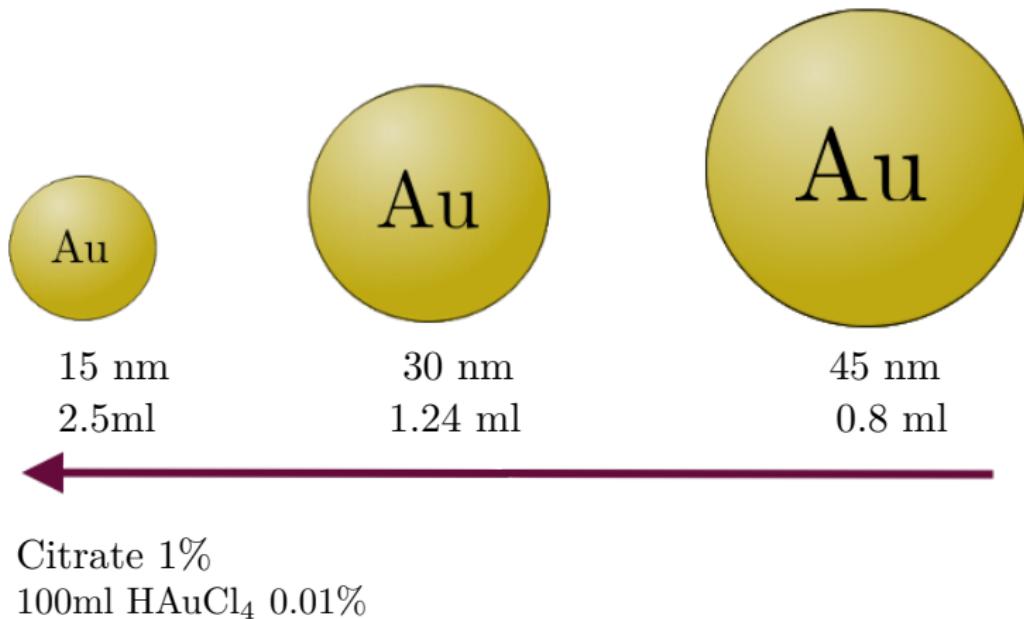
Gold ions: HAuCl₄ solution

Reducing agent: Na₃C₆H₅O₇

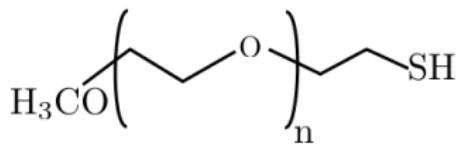
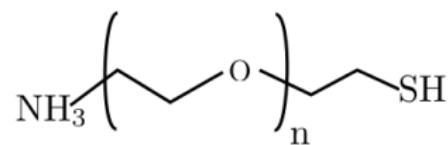
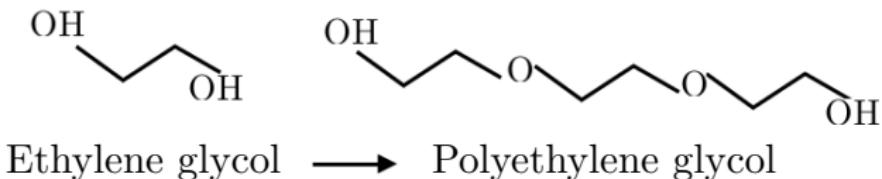
Reduction of gold ions to form GNP



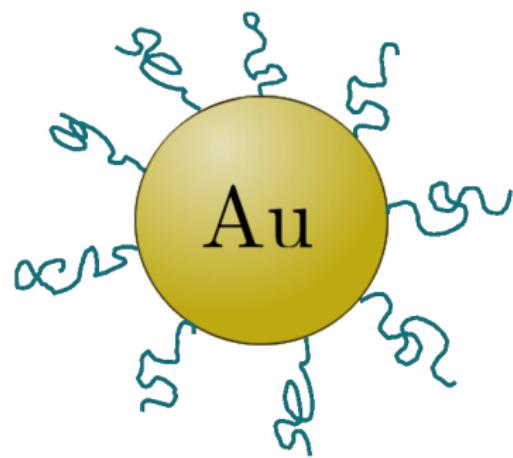
The amount of citrate controls the size



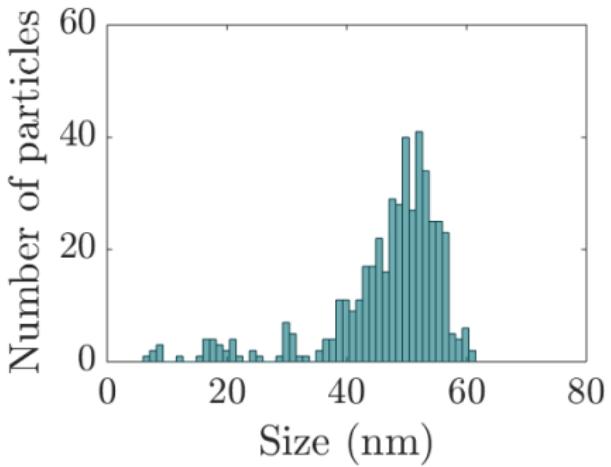
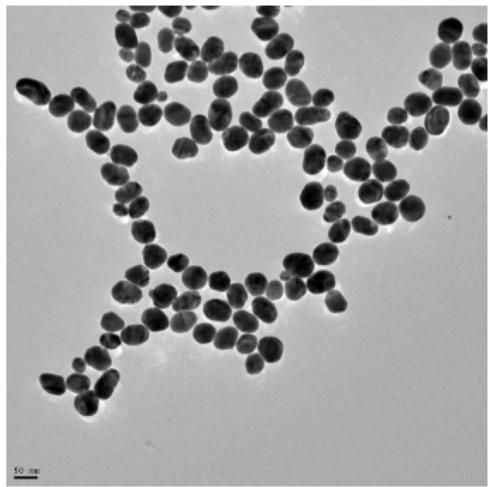
PEG for targeting and stabilization



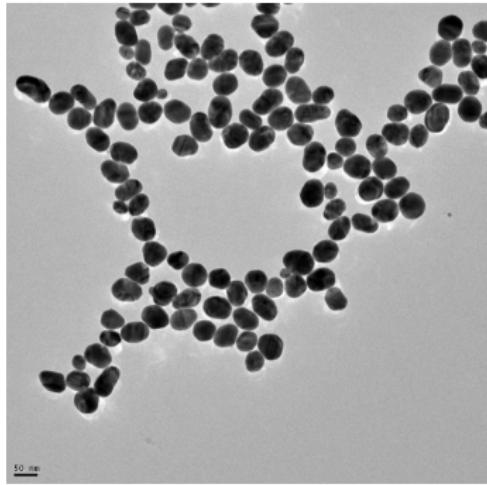
1k, 5k, 10k, 20k



TEM image analysis to determine the core diameter

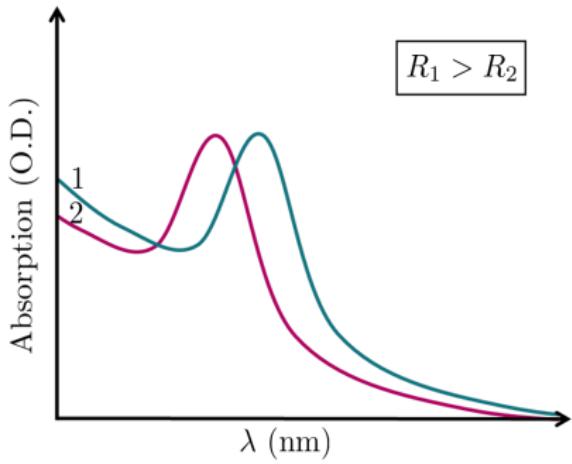
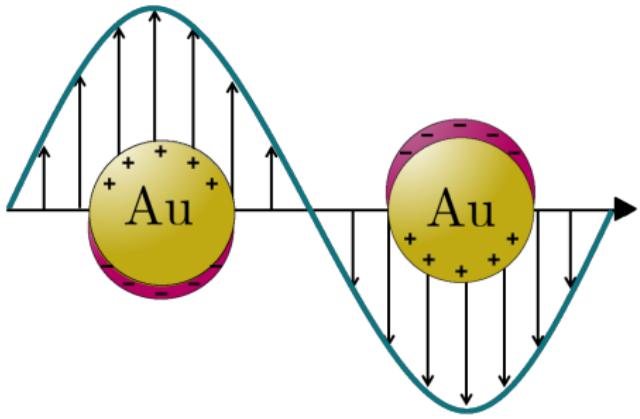


TEM image analysis to determine the core diameter

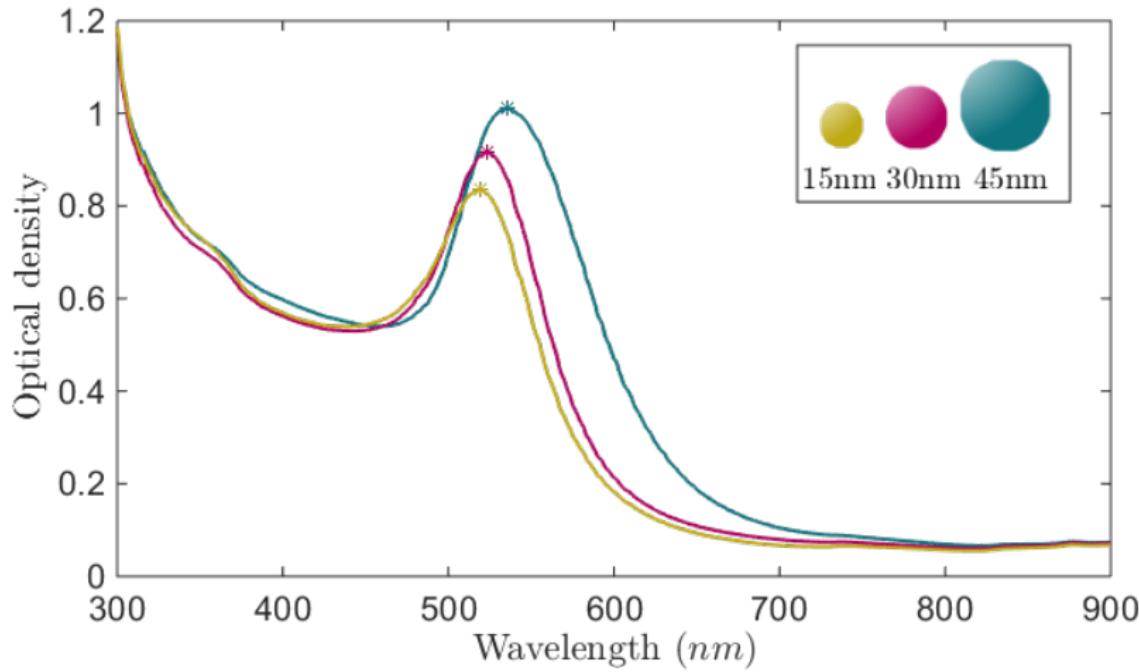


Exp. Size (nm)	Size (nm)
15	12.98 ± 0.23
	2.99 ± 0.16
30	18.29 ± 0.23
45	46.75 ± 0.47

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

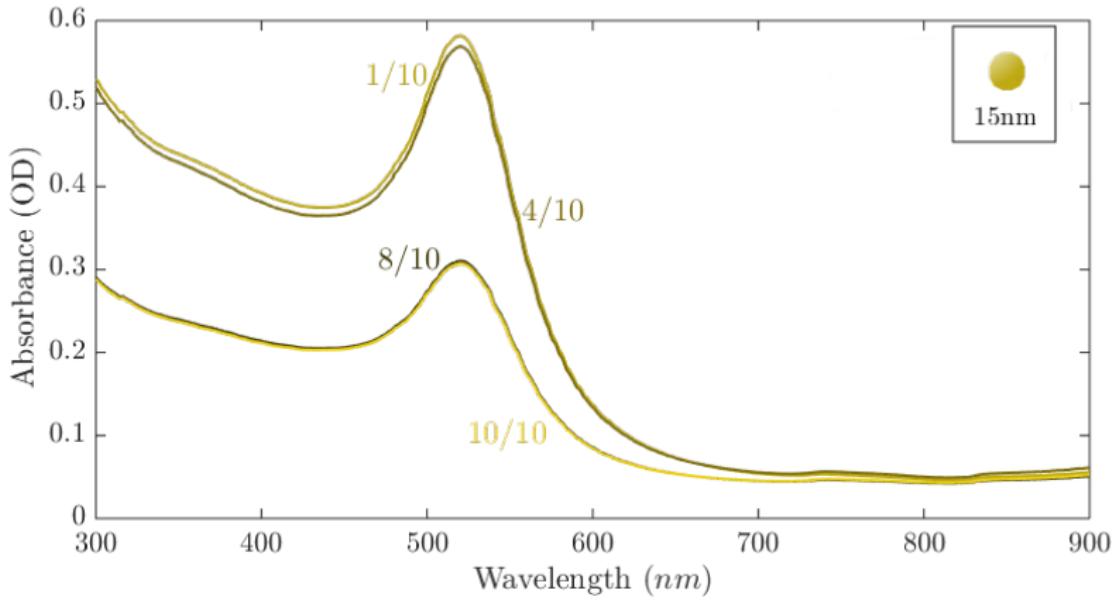


Absorption measurements (UV-Vis) to determine the relative size



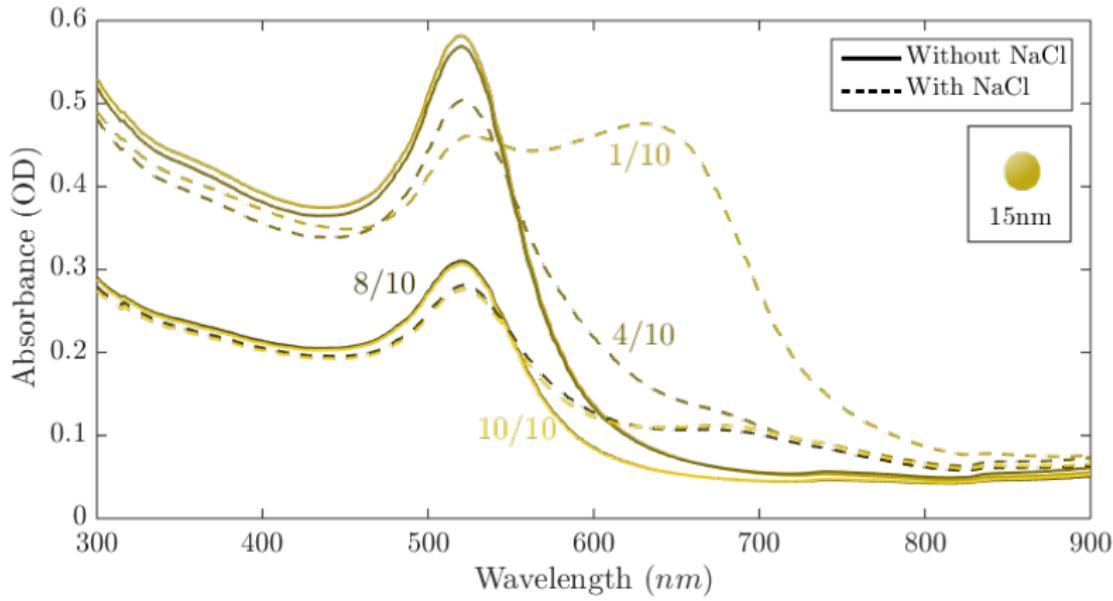
Absorption measurements (UV-Vis) to determine the optimal PEG proportion

1. Add PEG and preform UV-Vis measurement



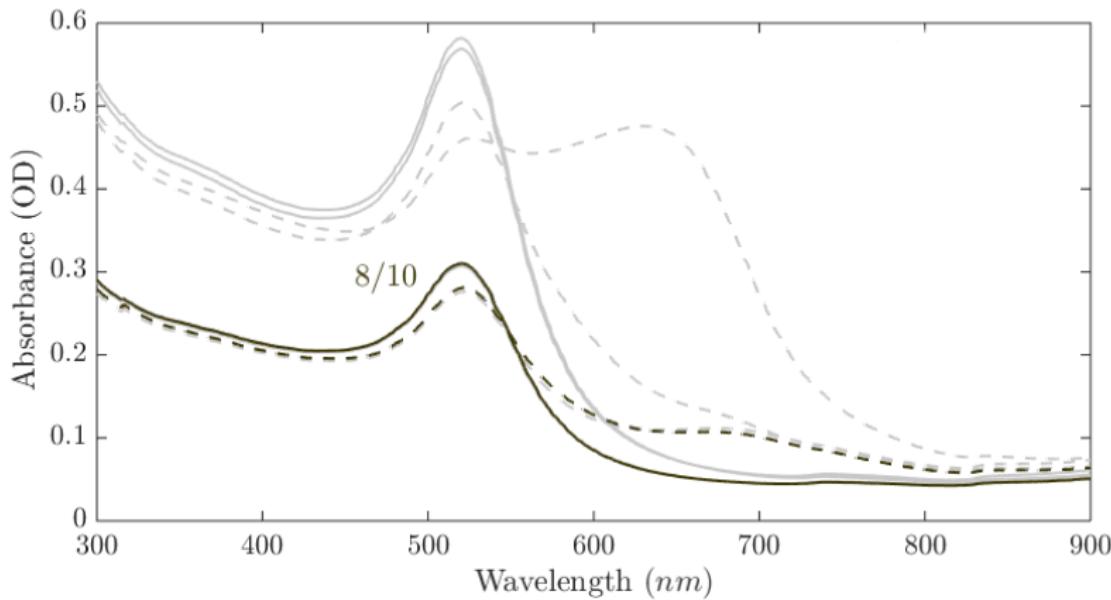
Absorption measurements (UV-Vis) to determine the optimal PEG proportion

2. Add NaCl and preform UV-Vis measurement



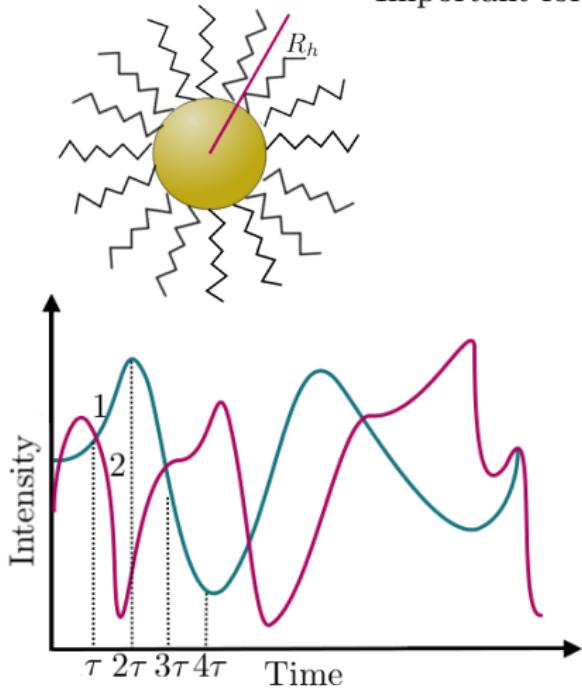
Absorption measurements (UV-Vis) to determine the optimal PEG proportion

bigger size → too little PEG
same size → enough PEG



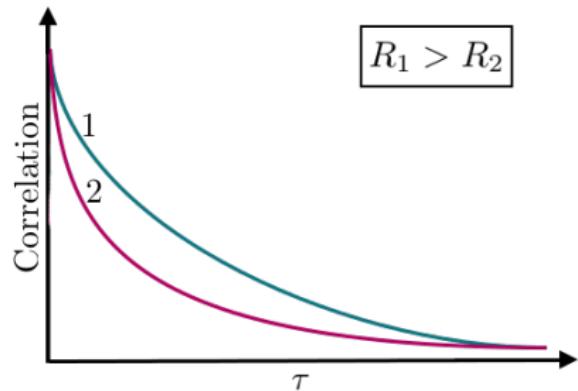
Light scattering experiments to determine the hydrodynamic radius (R_h)

Important for diffusive properties

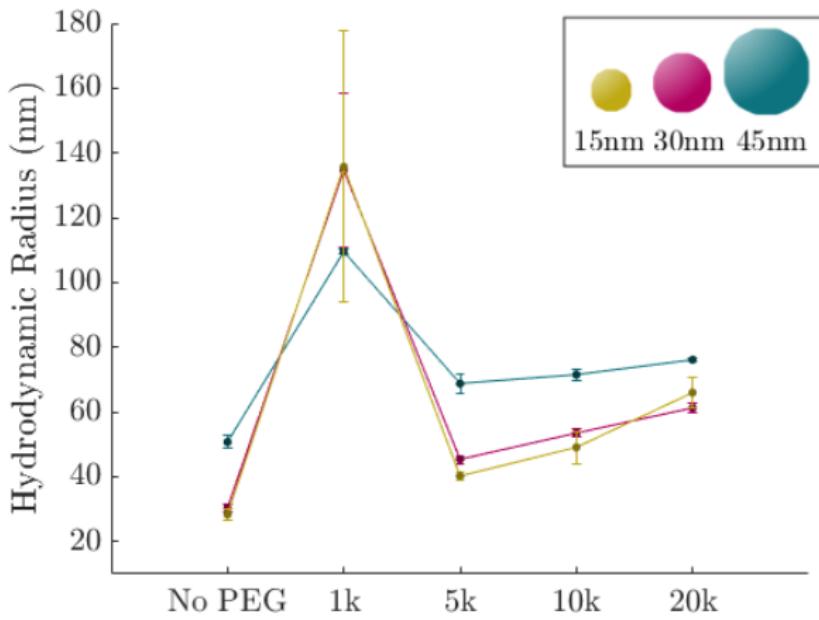


Correlation:

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



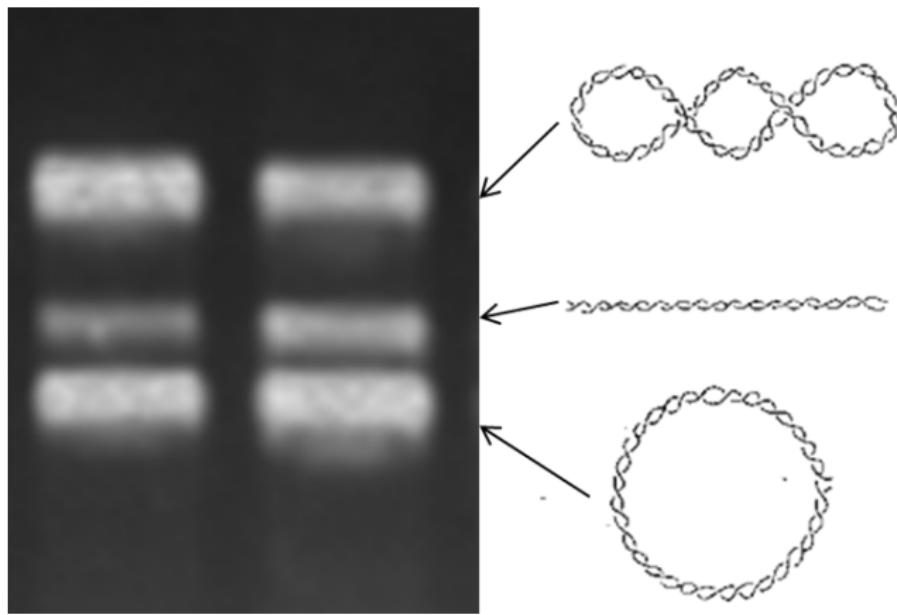
Hydrodynamic radii for the three different GNP with different functionalizations



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

