

# Bachelor Proef

## Semester II:

### Gold Nanoparticles:

- \* synthesis
- \* characterisation
- \* radiosensitization of DNA  
with GUP

Marnelore: 2030 lives: 50 Week: 15/02 - 21/02

Summary: first acquaintance + literature study

### Assistents:

- \* Mattias Vervaele → 200D 05.23  
Mattias.vervaele@fys.kuleuven.be  
Vaste-stoffysica en Magnetisme
- \* Bert De Roo → 200D 02.67  
bert.deroo@fys.kuleuven.be  
Vaste-stoffysica en Magnetisme
- \* Stephanie Sere → 200D 05.23  
stephanie.sere@fys.kuleuven.be  
Vaste-stoffysica en Magnetisme

### Goal:

- 1) Make/ synthesize GNP
  - 2) characterize them with the different techniques
  - 3) check/analyze the positive radiosensitization effect of GNP on DNA
- Very analogue to the masterthesis of Dennoert Liburiers  
→ we perform an extra test  
→ extra Data

Hannelore + Lies: 8u30

22/02/16

Summary: first acquaintance with the lab + synthesis GNP

- \* guided tour around the lab
- \* Synthesis GNP → protocol from Yvonne Wauters.
  1. A solution of 100ml 0.01%  $\text{HAuCl}_4$
  2. boiling Temperature & stirring
  3. Tree options:

15nm	→ 2.5 ml
30nm	→ 1.24 ml
45nm	→ 0.8 ml

1%  $\text{Na}_3\text{C}_6\text{H}_5\text{O}_7$
  4. boiling + stirring for 35 min.
  5. cooling down + protecting from light for 60 min
  6. Storing;  $4^\circ\text{C}$  + no light

Calculation:

$$\% \rightarrow \frac{m}{m}$$

we took ✓

↳ ✓

↳ NO GNP since wrong calculation  
(To little  $\text{HAuCl}_4$ )

- \* first acquaintance with characterization techniques
  - ↳ overview
- \* try out with DLS (Dynamic light scattering.)

## Overview Thesis

- ① Make GNP → protocol Lennaert + functionalize (PEG) Wouwers
- ② Characterize GNP
  - a. UV-Vis → core diameter
  - b. DLS → hydrodynamic radius
  - c. ξ-pot. → stability colloid
  - d. TEM → image + more exact core diameter
  - e. TGA → weight percentage difference + PEG capping density  $P_c$
- ③ Mix with DNA and irradiate
- ④ Gel electrophoresis to study the radiosensitization effect.

# Characterization Techniques

## ① UV-Vis (Ultraviolet-visible spectroscopy)

→ core diameter

\* UV-radiation

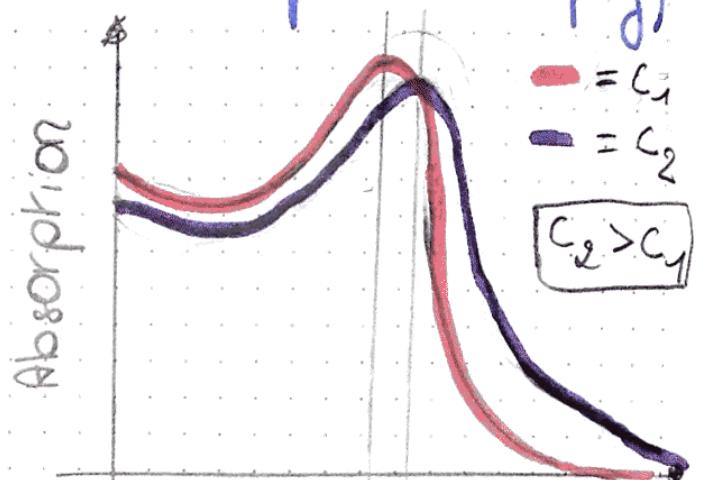
through sample

\* surface plasmons

→ resonant freq.

↳ depends on  
the size of NP

bigger → lower force → lower freq → bigger  $\lambda$  (nm)



## ② DLS (dynamic light scattering)

→ hydrodynamic radius

\* infrared radiation

through sample

\* Rayleigh scattering

→ measure  $I$

↳ variance due

to brownian motion of NP

\* Determine auto-correlation

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

\* different methods to analyze the data:

a) Cumulant Method/Algorithm

→ monodisperse solution

b) Padé-Laplace Method/Algorithm

→ polydisperse solution ( $PDI \geq 0.1$ )

polydispersity index

Background:

Brownian motion + Stokes-Einstein

$$P(r, t) = (4\pi D)^{-3/2} \exp(-r^2/4Dt) \quad D = k_b T / 6\pi \eta R_h$$

### ③ ξ-potential

→ stability of colloid

\* electrophoresis

→ 2 electrodes

\* measure constant  $\nu$

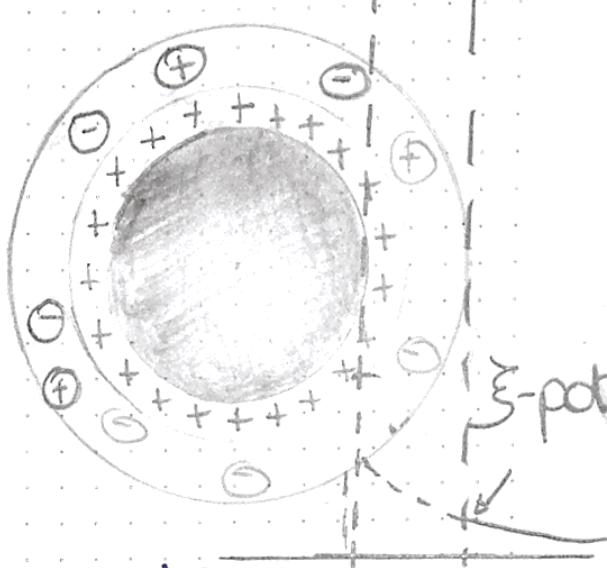
→ laser doppler

$$E \cdot q = \alpha \cdot \nu \Rightarrow \nu = \mu_e \cdot E$$

$$\text{with } \mu_e = q/\alpha$$

\* theoretical link  $\xi$ -pot:

$$\xi = \frac{2\eta \cdot \mu_e}{3\varepsilon} \cdot E \quad \begin{matrix} (\text{Smoluchowski approximation}) \\ \xrightarrow{\text{viscosity medium}} \xrightarrow{\text{dielectric constant medium}} \end{matrix}$$



⇒ if  $\xi \geq 30 \text{ mV}$   
stable colloid

### ④ TEM (Transmission electron microscope)

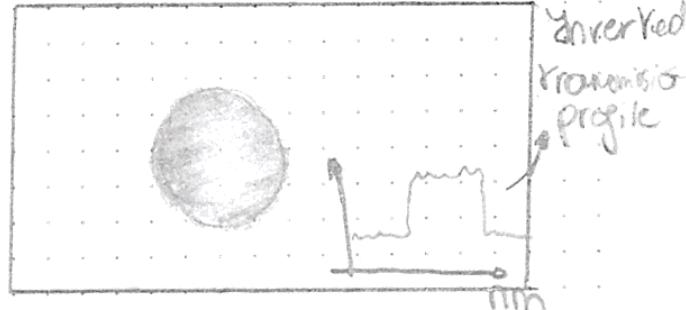
⇒ size/radius particles

↳ which one?  
\* heating cathode  
(tungsten filament)

\*  $e^-$  move to anode  
(with hole → beam  $e^-$ )

\* beam through sample

\* transmitted beam → fluorescent plate  
electronic picture



! Resolution depends on wavelength

### ⑤ TGA (Termogravimetric analysis)

⇒ weight percentage + PEG capping density  $P_c$

\* Weight monitoring as a function of Temp.

⇒ mass ratio gold

PEG

→  $M_{\text{PEG}} + P_{\text{gold}}$  → num. % ligands/particle

→ + surface area:  $P_c$



$$\text{Mushroom vs. Brush} \Rightarrow S = 2 \cdot \sqrt{\frac{1}{\pi R^2}} \quad | \quad S \geq R \approx N^{\nu} \text{ Flory radius}$$