Bachelor Thesis 2016

Radiosensitization using gold nanoparticles

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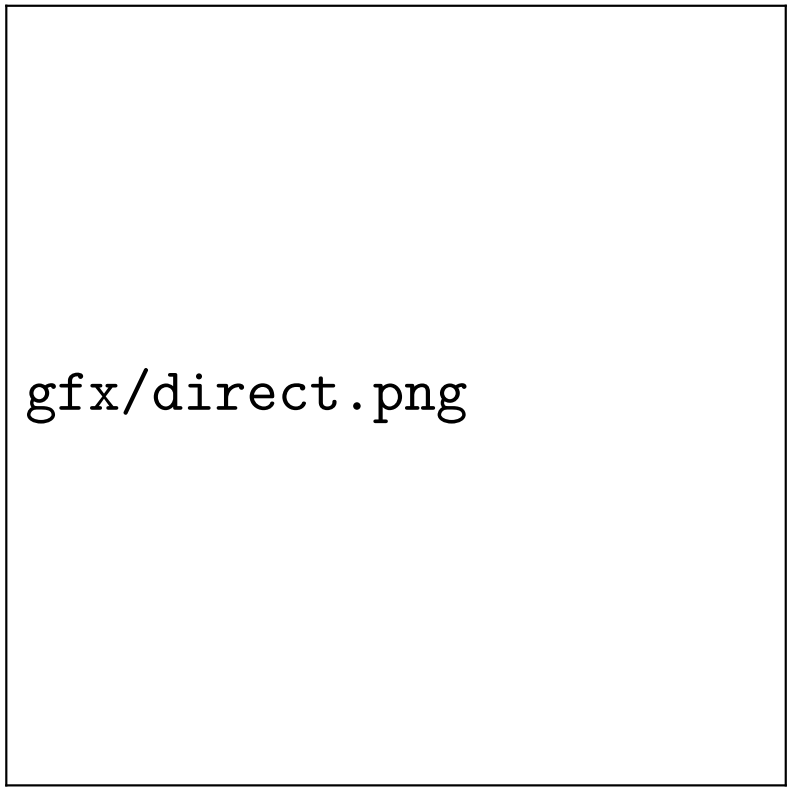
Source: A. Chaudhary , A. Gupta , S. Khan and C. Kanti Nandi *Phys. Chem. Chem. Phys.*, 2014 **16**

Cancer treatment

- Chemotherapy
- Surgery
- **Radiation therapy**

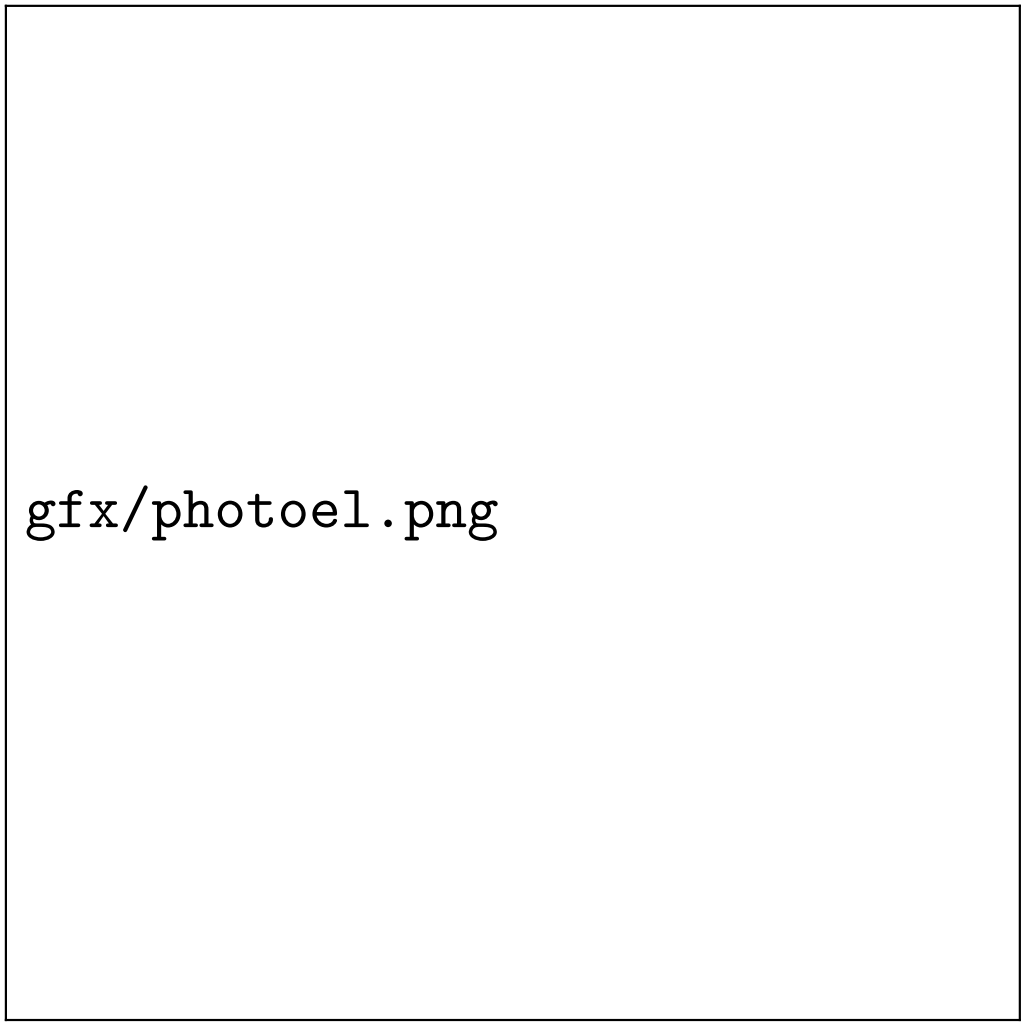
  Energy $\sim MeV$



Source: https://chem.kuleuven.be/veiligheid/info/ioniserende-st.htm

Radiosensitization with GNP E ~ keV

Photoelectric absorption



Compton effect

Why gold?

- High atomic number (79)

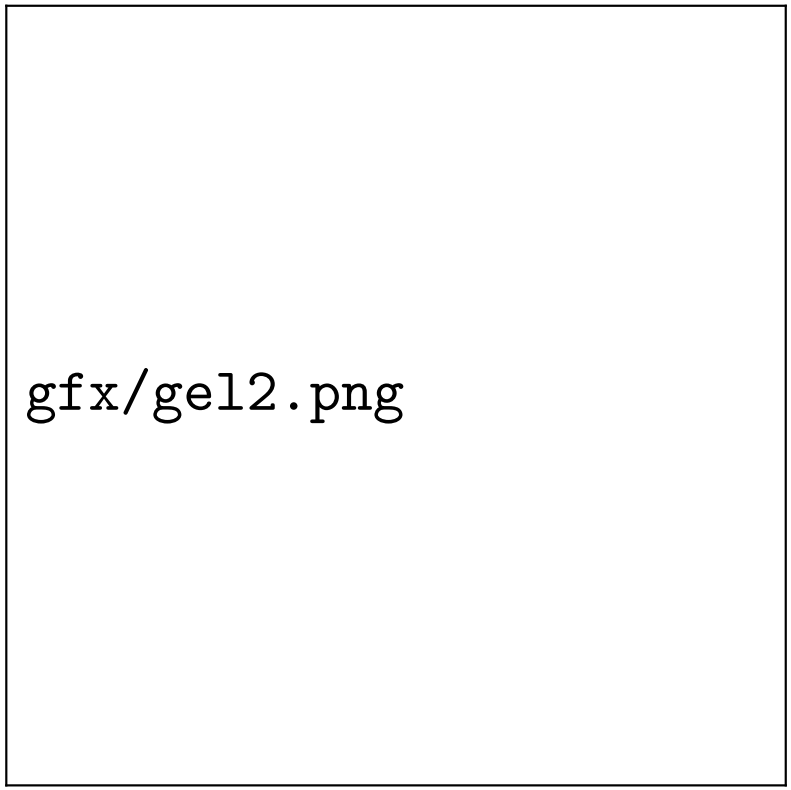
Targeting

Passive targeting
PEG coating

Active targeting
Antibodies

Goal

1. Synthesis
2. Characterization
3. Radiosensitization



Source: E. Bruna, L. Sancheb, C. Sicard-Roselli, *Colloids and Surfaces B: Biointerfaces*, 2009, **72**

Chemical protocol

Gold ions: $HAuCl_4$ solution
Reducing agent: $Na_3C_6H_5O_7$

Chemical protocol

$$6Au^{3+} + C_6H_5O_7^{3-} + 15OH^- \rightarrow Au + 6CO_2 + 10H_2O$$

Size GNP

Citrate 1%
100ml $HAuCl_4$ 0.01%

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

gfx/uvvis.png

Results

GNP no PEG

gfx/vis1.png

Results

15nm GNP 20k PEG for different PEG/GNP

Results

15nm GNP 20k PEG for different PEG/GNP

gfx/vis33.png

Results

15nm GNP 20k PEG for different PEG/GNP

gfx/vis44.png

Overview

- Introduction
- Synthesis GNP
  - Chemical Protocol
  - Size GNP
- Stabilization
- Characterization
  - Size GNP
    - Chemical Protocol
    - UV-VIS
    - TEM
  - Hydrodynamic Radius
    - DLS

Source: A. Chaudhary , A. Gupta , S. Khan and C. Kanti Nandi *Phys. Chem. Chem. Phys.*, 2014 **16**

Dynamic light scattering (DLS)

Hydrodynamic radius (R_h)

$\rightarrow$ Rayleigh scattering

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

$$R_2 < R_1$$

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