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Poly(2-oxazoline)s-based nanovectors for PhotoDynamic Therapy

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This research master's degree research project could be followed by a PhD. YES □ NO X

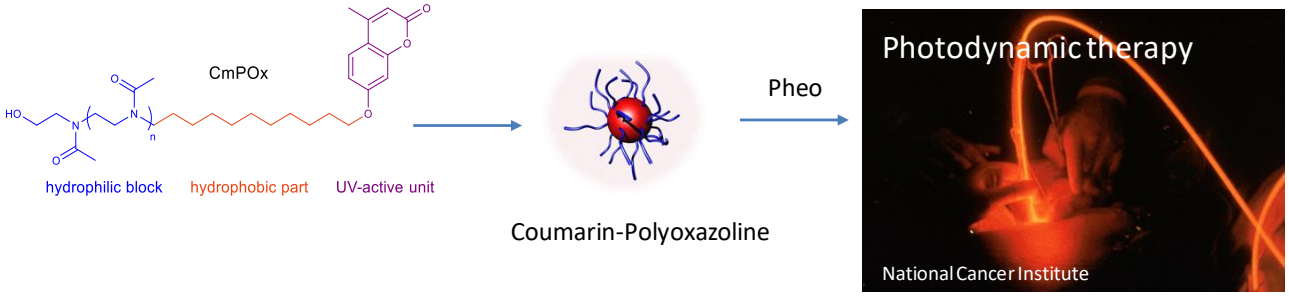
Abstract/work package/short bibliography/illustration

The future of medicine lies in nanomedicine: the use of nanometric vectors to deliver the desired molecules to the desired site. For diseases such as cancer, it is essential. Photodynamic therapy (PDT), a technique already clinically used, is based on the irradiation of a photosensitizer, which transfers its energy to oxygen, leading to reactive oxygen species that kill the local cells. PDT suffers today from an inadequate biodistribution of the photosensitizer, leading to a patient skin photosensitivity over several days. We have shown in previous studies that encapsulating the photosensitizer in a polymer vector strongly improves the PDT efficiency. However, our vectors are based on amphiphilic block copolymers, with a hydrophilic block constituted of poly(ethylene glycol) (PEG). In nanomedicine, 90 % of the vectors are also based on this polymer because it enables the vector to remain in the bloodstream for very long times, enabling its concentration in the desired area to be treated in ca. 2 days. If this looks like the magic component, in fact, it is not, because studies have been increasingly showing that upon several injections of PEG-based nanovectors, immune responses appear, and this leads to a rapid clearance of the vectors.

We have begun to assess a new type of vectors, based on poly(2-oxazoline) for PDT. This internship is the follow up of this topic. The work of the trainee will consist in:

- assessing the ability of forming polymeric nanovectors (micelles or polymer vesicles) with a range of poly(2-oxazolines), depending on their molecular weight and their composition. This will use different techniques for the characterization: static/dynamic light scattering, transmission electron microscopy (TEM), cryo-TEM, tensiometry
- crosslinking the vectors by light, thanks to the presence of a photo-reactive group on the polymer chain. This provides more stability to the vectors. Crosslinking will be assessed by ^{1}H NMR

In collaboration with a biologist of our team, the trainee will attend the performing of biological tests to evaluate the PDT efficiency of best vectors.



Coumarin-Polyoxazoline

References

- Amphiphilic polymers based on Polyoxazoline as relevant nanovectors for Photodynamic Therapy
  A. Oudin et al. J. Mat. Chem. B (2019) DOI: 10.1039/c9tb00118b
- Extended photo-induced endosome-like structures in Giant Vesicles promoted by block-copolymer nanocarriers
  C. Montis et al. *Nanoscale* (2018) **10** 15442 – 15446
- Polymeric micelles encapsulating photosensitizer: structure/ photodynamic therapy efficiency relation
  L. Gibot et al. *Biomacromolecules*, **15**(4) (2014)1443-1455

Keywords, areas of expertise (max 30 words)	Polymers, nanomedicine, physical chemistry
Required skills for the internship (max 30 keywords)	Rigorousness, scientific curiosity