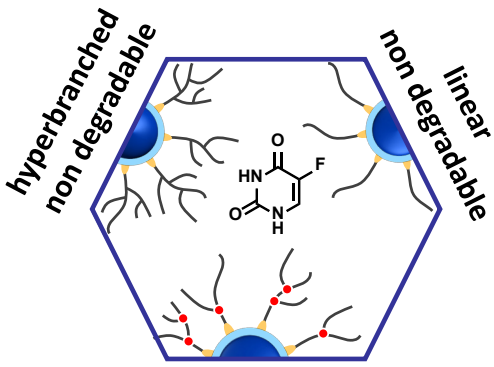
Polymer grafted on upconversion nanoparticles for drug delivery

at the Institut Charles Sadron, Strasbourg (France)

DOCTORAL PROJECT

The treatment of diseases by medication is widely used and involves the vectorization of drugs. However, these drugs can be confronted with various biological barriers, degraded by a physiological environment too harsh for them, and released far from the target site making them less effective. Various strategies have been considered including drug formulation, encapsulation in a degradable capsule, but also the development of polymer-based vectors. These polymers can be modulated in terms of composition, topology and functionalities in order to meet the needs of the targeted application and adapt the vector to the nature of the drug used.[1]

Lanthanide-doped upconversion nanoparticles (UCNPs, in dark blue on the figure) have received growing interest in biomedicine, particularly for bioimaging and photodynamic therapy.[2] These nanoparticles are capable of converting excitation light in the near infrared into emission light in the visible or ultraviolet spectral range. In medical bioimaging, UCNPs have interesting properties compared to organic luminescent probes and quantum dots: minimal background autofluorescence, low photobleaching and photoblinking, and increased depth of light penetration in biological tissues for example. UCNPs are also used for photodynamic therapy: irradiation of UCNPs in the near infrared leads to an emission of light in the visible that activates a photosensitizer producing singlet oxygen that kills cancer cells. We have recently demonstrated the possibility to grow linear and hyperbranched polymers from the surface of UCNPs and their ability to encapsulate and release a drug while maintaining good luminescence properties.[3] The objective of this doctoral project will be to adjust the structure, composition and functionality of the polymer for cancer therapy.



hyperbranched redox-degradable

References

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2. a) Wang C, Cheng L, Liu Z. *Theranostics* **2013**, *3*, 317, b) Guryev EL, Smyshlyaeva AS, Shilyagina NY, Sokolova EA, Shanwar S, Kostyuk AB, Lyubeshkin AV, Schulga AA, Konovalova EV, Lin Q, Roy I, Balalaeva IV, Deyev SM, Zvyagin AV. *Molecules* **2020**, *25*, 4302

3. a) Kavand A, Blanck C, Przybilla F, Mély Y, Anton N, Vandamme T, Serra CA, Chan-Seng D. *Polym. Chem.* **2020**, *11*, 4313; b) Kavand A, Anton N, Vandamme T, Serra CA, Chan-Seng D. *Eur. Polym. J.* **2020**, *137*, 109935

CONTEXT

This doctoral project will be carried out at the Charles Sadron Institute whose scientific mission covers polymers and self-assembled systems sciences under the direction of Delphine Chan-Seng and Christophe Serra. We are looking for a motivated student with a solid background in organic chemistry interested in an interdisciplinary project. The student will acquire during this PhD program skills in particular in polymer chemistry and inorganic nanoparticle synthesis. If you are interested in this doctoral project, please send a cover letter explaining why you wish to work on this project, your Master's transcripts and a CV to Delphine Chan-Seng (delphine.chan-seng@ics-cnrs.unistra.fr) before April 4, 2021. The funding of this project will be through a competition for a doctoral contract from the Doctoral School of Chemical Sciences of the University of Strasbourg. The candidate will therefore have to have a strong application in order to be selected for and during the audition by the doctoral school.