Designing smart vesicles for drug delivery

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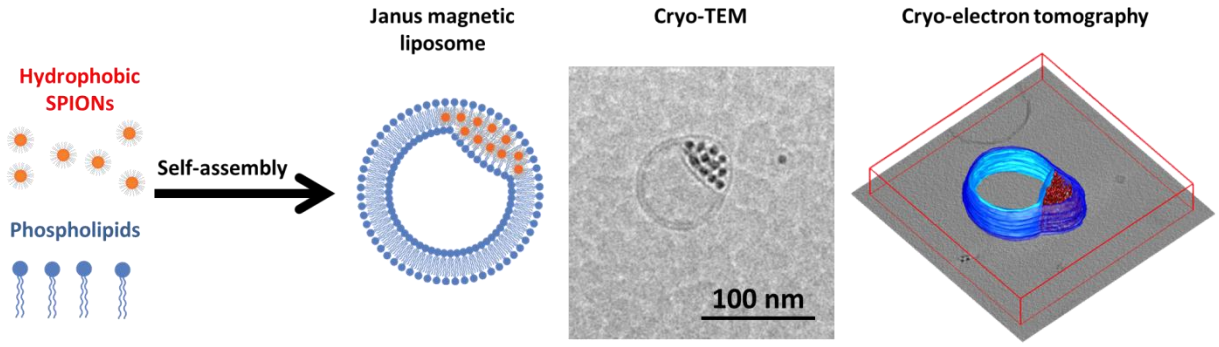
Delivering and releasing drugs at their target in a controlled fashion remains a key determinant of successful treatment. Liposomes acting as basic drug carriers are forerunners in this development, and combining them with various stimuli-responsive nanoparticles – which act as release triggers - has become an increasingly popular methodology to control the spatial and temporal release of an encapsulated drug. Developing such hybrids however requires an interdisciplinary bottom-up approach which starts from basic chemical synthesis over precise microscopic characterization to biological settings.

In our research group, we apply nanoparticles of different materials (i.e. superparamagnetic iron oxide nanoparticles/SPIONs and gold nanorods/AuNRs) and combine them with thermoresponsive liposomes, either by incorporating them directly in the vesicle bilayer (i.e. via self-assembly) or by functionalizing them to the surface (i.e. via cross-linking). These materials are biocompatible and meticulously tuned to react to a maximum degree to various stimuli (i.e. magnetic and light) - which are presently found in medical settings - to consequently facilitate the transition from bench to bedside. To optimize our systems, we characterize these nanoscopic hybrids with state-of-the-art cryogenic microscopy techniques to assess their structural and architectural properties under unadulterated conditions. This approach has recently led to the development of Janus magnetic liposomes[1], which were designed by deeply understanding and steering of the liposome self-assembly process.

With this research, we hope to contribute to the development of next-generation drug carriers by providing effective, well-characterized and reliable materials to treat conditions such as cancer and inflammatory diseases.



[1] Bonnaud, C.*, Monnier, C. A.*, Demurtas, D., Jud, C., Vanhecke, D., Montet, X., ... & Petri-Fink, A. (2014). Insertion of Nanoparticle Clusters into Vesicle Bilayers. *ACS Nano*, *8*(4), 3451-3460.