Drug releasing nanocomposites by NIR light or magnetic field for nanomedecine

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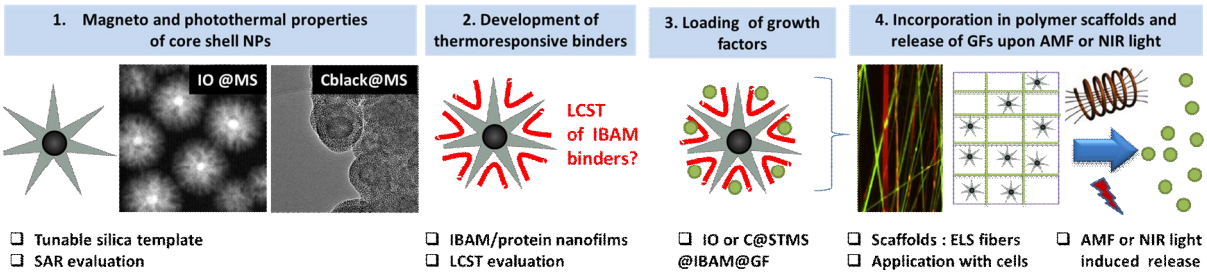
Today, there is an important challenge to design smart stimuli-responsive carriers that can respond remotely to magnetic field or near infrared (NIR) light by releasing drugs[1] for anticancer treatments or tissue engineering. In the field of biomaterials, such nanoplatforms could be for instance, incorporated within implantable scaffolds and release remotely biological factors upon externally applied waves and be followed by multi-imaging.

Very recently, we engineered original nanoplatforms composed of magnetic or carbon-based materials cores (coll. Dr. Bégin, ICPEES), surrounded with mesoporous silica shell optimized for magnetic hyperthermia or NIR photothermal therapy and dug loading/ release.[2,3] Furthermore, to afford a biocompatible interface, we developed a variety of protein based nanocapsules and coatings ensuring a suitable contact with blood and cells.[4,5] However, one key step is the design of thermally responsive gatekeeper able to retain and to deliver efficiently the drugs at a desired time and location.

In this PhD work, in addition to the development of smart activable nanocomposites, one important challenge will be thus to develop new suitable and biocompatible thermoresponsive coating of such nanocomposites to ensure a better drug release. For that, new types of carbon or magnetic cores will be tested and large pore mesoporous silica around these cores will be designed for the loading of large biological drugs. Furthermore, various thermo-responsive coatings based on biocompatible well-established LCST polymers or polypeptides will be investigated.

Finally such platforms will be envisioned for integration within a polymer scaffold (Electrospun fibers (ELS) in coll. with Prof G. Schlatter (ICPEES). In vitro/in vivo biological studies will be performed for the magnetic response in coll. with Prof F. Meyer (INSERM U1121) and for the NIR light response in coll. with Dr. S. Harlepp (INSERM U1109).



This PhD work is pluri-disciplinary at interfaces between chemistry, physics, and biomaterials. Various chemical methods and instrumentation techniques will be used for characterizing the activable nanocomposites: ITC, DSC, UV visible, fluorimetry, STEM,TEM.

References:

[1] D. Mertz, O. Sandre, S. Bégin-Colin, *Biochim. Biophys. Acta BBA - Gen. Subj.* **2017**, *1861*, 1617ï 1641.
[2] C. Wells, O. Vollin-Bringel, V. Fiegel, S. Harlepp, B. Van der Schueren, S. Bégin-Colin, D. Bégin, D. Mertz, *Adv. Funct. Mater.* **2018,** *In press,* doi: 10.1002/adfm.201706996.
[3] V. Fiegel, S. Harlepp, S. Bégin-Colin, D. Begin, and D. Mertz, *Chem. Eur. J.,* **2018***, In press*, doi:10.1002/chem.201705845.
[4] D. Mertz, J. Cui, Y. Yan, G. Devlin, C. Chaubaroux, A. Dochter, R. Alles, P. Lavalle, J. C. Voegel, A. Blencowe, *ACS Nano* **2012**, *6*, 7584ï 7594.
[5] D. Mertz, C. Affolter-Zbaraszczuk, J. Barthès, J. Cui, F. Caruso, T. F. Baumert, J.-C. Voegel, J. Ogier, F. Meyer, *Nanoscale* **2014**, *6*, 11676ï 11680.