Functionalization of second harmonic generation nanoparticles for theranostic applications

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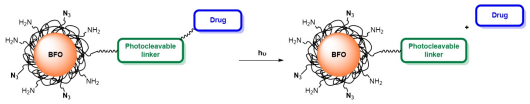
Nowadays, cancer is the leading cause of death in developed countries. The emergence of new multimodal nanodevices for *in vivo* imaging offers the perspective of cancer detection at a very early stage.[1] The recent progress in nanotechnologies has generated high expectation that nanomaterials could provide unprecedented contrast agents in imaging set-ups and multifunctional platforms for drug delivery.[2] In this context, harmonic nanoparticles (HNPs), which are composed by non-centrosymmetric materials, can be easily imaged by their second harmonic generation signal in multiphoton imaging platforms.[3]



We recently disclosed efficient protocols for the biocompatible coating [4] and post-functionalization of bismuth ferrite ($BiFeO_3$, BFO) and $LiNbO_3$ HNPs as well as their favorable properties for targeted imaging of human cancer cells and tissue.[5] We report therein the conjugation of BFO HNPs to caged molecular cargos through a photocleavable linker based on coumarinyl and *o*-nitrobenzyl derivatives. Excitation of these functionalized HNPs in the visible or near IR region generated second harmonic UV emission [6] and subsequent selective release of the conjugated drug models.

These multifunctional HNPs offer the possibility for decoupled imaging modality and photo-activation process by tuning the wavelength of the excitation beam.

[1] Smith, L.; Kuncic, Z.; Ostrikov, K. K.; Kumar, S. *J. Nanomater*. 2012, Article ID 891318, 7 pages.
[2] Nguyen, K. T.; Zhao, Y. *Acc. Chem. Res*. **2015,** *48*, 3016-3025.
[3] Bonacina, L. *Mol. Pharm*. **2012**, *10*, 783-792.
[4] Staedler, D.; Passemard, S.; Magouroux, T.; Rogov, A.; Maguire, C. M.; Mohamed, B. M.; Schwung, S.; Rytz, D.; Juestel, T.; Hwu, S.; Mugnier, Y.; Le Dantec, R.; Volkov, Y.; Gerber-Lemaire, S.; Prina-Mello, A.; Bonacina, L.; Wolf, J.-P. *Nanomedicine: NBM* **2015**, *11*, 815-824.
[5] Passemard, S.; Staedler, D.; Sonego, G.; Magouroux, T.; Schneiter, G. S.; Juillerat-Jeanneret, L.; Bonacina, L.; Gerber-Lemaire, S. *J. Nanopart. Res*. **2015**, 17:414; Rogov, A.; Irondelle, M.; Ramos-Gomes, F.; Bode, J.; Staedler, D.; Passemard, S.; Courvoisier, S.; Yamamoto, Y.;Waharte, F.; Ciepielewski, D.; Rideau, P.; Gerber-Lemaire, S.; Alves, F.; Salamero, J.; Bonacina, L.; Wolf, J.-P. *ACS Photonics* **2015**, *2*, 1416-1422.
[6] Staedler, D.; Magouroux, T.; Passemard, S.; Schwung, S.; Dubled, M.; Schneiter, G. S.; Rytz, D.; Gerber-Lemaire, S.; Bonacina, L.; Wolf, J.-P. *Nanoscale* **2014**, *6*, 2929-2936.