Biodegradable silsesquioxane composite nanomaterials for biomedical applications

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Biodegradable nanomaterials have attracted a lot of attention in biomedical research for their higher potential to reach the emerging industrial market of nanomedicine. The uncertainty of the toxicity, particle accumulation, and the known limited biocompatibility of nanomaterials greatly hinder their successful clinical trials to be approved as pharmaceutical products. Various biodegradable nanomaterials have thus been reported with organic and polymeric nanostructures such as liposomes, micelles, polylactic acid, polylactide-co-glycolide, etc. Biodegradable inorganic NPs are much rarer but include silicon, calcium and manganese phosphate nanoparticles. However, biodegradable porous organic-inorganic nanocomposites are especially desirable for they may garner the biodegradability features of organic constituents as well as the robustness and properties of an inorganic matrix.

The lecture will describe four strategies to design silsesquioxane nanomaterials from tetra- or di-substituted bridged alkoxysilanes for biomedical applications. Such silica hybrids possess very high organic contents ranging from 30 to 70 percent in mass, which uniquely impacts their properties. Non-porous and mesoporous bridged silsesquioxane nanoparticles with 50 to 200 nm in diameter, endowed with redox- and enzymatic-responsiveness will be presented for one and two-photon fluorescence imaging, one and two-photon-excited photodynamic therapy, and drug delivery.

References

1. J.G. Croissant, C. Mauriello-Jimenez, X. Cattoën, M. Wong Chi Man, L. Raehm, M. Maynadier, M. Gary-Bobo, M. Garcia, P. Maillard, J-O. Durand, "Synthesis of disulfide-based biodegradable bridged silsesquioxane nanoparticles for two-photon imaging and therapy of cancer cells", *Chem. Commun.* **2015**, *51*, 12324.

2. Y. Fatieiev, J. G. Croissant, K. Julfakyan, L. Deng, D.H. Anjum, N.M. Khashab, "Enzymatically degradable hybrid organic-inorganic bridged silsesquioxane nanoparticles for in-vitro imaging", *Nanoscale* **2015**, NR-COM-05-2015-003065.R1.

3. J.G. Croissant, X. Cattoën, M. Wong Chi Man, A. Gallud, L. Raehm, M. Maynadier, J-O. Durand, "Biodegradable ethylene-bis(propyl)disulfide-based periodic mesoporous organosilica nanorods and nanospheres for efficient in-vitro drug delivery", *Adv. Mater.* **2014**, *26*, 6174.

4. J.G. Croissant, Y. Fatieiev, H. Omar, K. Julfakyan, Lin Deng, D.H. Anjum, J. Lu, F. Tamanoi, J.I. Zink, N.M. Khashab, "Enzymatically-biodegradable mesoporous organosilica nanocomposites with exceptionally high hydrophilic and hydrophobic drug loading delivery", under writing, **2015**.