Recent insights into the intracellular chemistry of silica

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The design of silica-based (nano)materials for drug delivery and tissue repair is a major field of today's medical research. However, the bio-chemical processes by which they interact with our cells and tissues remain largely unknown. While evidences have been gathered that silicon can play a beneficial role in mammalian tissue formation, especially bone, the existence of specific silicon-related metabolic pathways is yet to be demonstrated.

The intracellular space of mammalian cells represents an interesting environment to evaluate catabolic processes. Over the last 10 years, we and others have studied the intracellular fate of silica nanoparticles exhibiting various sizes, morphology, composition and structure.[1] Overall these studies evidence that these particles are uptaken, partially degraded and then released, together with their degradation products, *i.e.* silicic acid.[2] Our most recent work suggests that this occurs via hydrolytic dissolution and not through a specific bio-degradation process.[3] However, the confinement of the particles within intra-cellular compartments does have an effect on the course of degradation. The presence of bio-sensitive elements within the silica backbone also allows for tuning the degradation mechanisms.[4] Finally, we will demonstrate that the intracellular release of silicic acid can also have some beneficial effects for the cells.[5]

However, as emphasized in our conclusion, our understanding of silica bio-chemistry still faces many challenges, especially from an analytical perspective, that are inherent to the complex reactivity of silicon in aqueous environments.

[1] For a recent review, see: J. G. Croissant, Y. Fatieiev, N. Kashab, *Adv. Mater.* **2017**, *29*, 1604634.
[2] S. Quignard, G. Mosser, M. Boissière, T. Coradin, *Biomaterials* **2012**, *33*, 4431-4442.
[3] Y. Shi, C. Hélary, T. Coradin, *Langmuir* **2018**, *34*, 406-415.
[4] S. Quignard, S. Masse, G. Laurent, T. Coradin, *Chem. Commun*. **2013**, *49*, 3410-3412.
[5] S. Quignard, T. Coradin, J. J. Powell, R. Jugdaohsingh, *Colloids Surf. B.* **2017**, *155*, 530-537.