Organo-Inorganic Hybrids: Design of Novel Molecular Recognition and Biocatalytic Nanomaterials

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In nature, a number of organisms have the ability to produce intricately patterned and hierarchically structured biogenic silica. Oppositely to these natural systems, the chemical production of high-value siliceous materials typically involves harsh conditions, environmentally detrimental waste streams, and often-toxic precursors. Imitating natural systems' ability to produce hierarchical silica structures, in close-to-neutral conditions, may circumvent these deleterious effects with the additional possibility to reach the same degree of complexity and functionality. In this lecture, two novel design strategies of nanomaterials capable of either molecular recognition or biocatalysis will be discussed; both approaches are based on the self-assembly of organo-silica precursors around protein templates.

The first part of this presentation will be dedicated to the development of a novel class of nanoparticles possessing enhanced molecular recognition properties of viruses.[1] The synthetic strategy to produce those nanoparticles is based on the formation of a chemical imprint of the template virion at the surface of silica nanoparticles; *cf. Figure 1*. It is demonstrated that the so-produced particles possess enhanced molecular recognition properties for their target, even in complex media (*e.g.* human serum). The second part of this lecture will be dedicated to the development of a chemical strategy to produce nanobiocatalysts with enhanced biochemical, physical and chemical stabilities. It is based on the formation of a protective shell at the surface of enzyme proteins that provides a comfortable medium that allows for enzyme stabilization. It will be demonstrated that those systems can find "real-life" biotech applications.

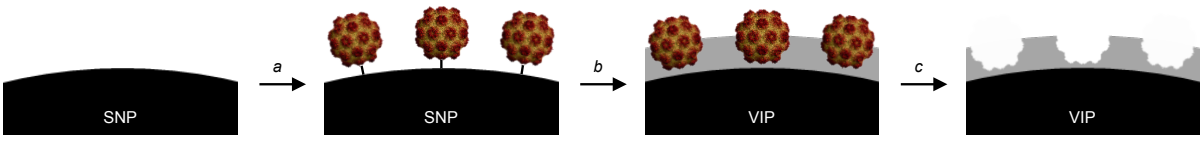

Figure 1: *Schematic strategy for the design of virus-imprinted nanoparticles (VIPs)*

1. A. Cumbo, B. Lorber, P. F.-X. Corvini, W. Meier, P. Shahgaldian, *Nat. Commun.* **2013**, *4*, 1503