Hybrid nanoparticles for diagnostics and bio applications

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Advancements in the use of nanoparticles for biomedical applications have clearly shown their potential for the preparation of improved imaging and drug-delivery systems. However, only a few successfully materials translate into clinical practice, because, of their incomplete elimination, difficulties to cross barriers and lack of selectivity. We have recently reported disulfide-bridged organosilica nanoparticles with cage-like morphology, and assessed in detail their toxicity and bioaccumulation *in vitro* and *in vivo* [1-3]. We have also shown targeting behavior when the nanoparticles are covered with exosome membranes [4].
Exploring further the use of responsive organic groups we have created organosilica nanoparticles containing single-stranded nucleic acids. The oligonucleotides, can be covalently embedded in the silica network, and their behavior has been investigated [5]. However, the system can be programmed to be more dynamic and responsive by designing supramolecular organo-silica systems based on PNA- derivatives that can self-assemble through direct base paring or can be joined through a bridging functional nucleic acid, such as the ATP-binding aptamer [6].
These systems can be followed by confocal microscopy in different cell lines and their biological effect was measured in cells to assess the biological effect of the aptamer.
Finally, responsive capsules able to entrap large biomolecules are described, with the aim to enhance coral settlement through the development of biomimetic microhabitats that replicate the chemical landscape of healthy reefs. We engineered a soft biomaterial, SNAP-X, composed of silica nanoparticles, biopolymers and algal exometabolites, to enrich reef microhabitats with bioactive molecules from crustose coralline algae. Coral settlement was enhanced over 20-fold using SNAP-X coated substrates compared to uncoated controls. SNAP-X is designed to gradually release chemical signals slowly (> 1 month) under natural seawater conditions, and it can be rapidly applied to natural reef substrates via photopolymerization, further facilitating the light-assisted 3D printing of microengineered habitats[7].

References

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