Smart mesoporous silica nanostructures towards improved delivery performance

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The development of nanotechnologies has opened up a range of possibilities in the integration of nanoscale containers loaded with active components to deliver under suitable external stimuli for a variety of applications, ranging from smart drug delivery system of biomedical interest, to corrosion inhibitor carriers able to release their cargo locally only triggered by onset of corrosion phenomena.
Among several types of nanocontainers and encapsulation approaches proposed and investigated to realize smart nanocarriers, mesoporous silica nanoparticles (MSNs) represent ideal candidate for designing carrier with high load capacity in which cargo release is controlled by a suitable surface functionalization, enabling a sustained release in response to external stimuli, as delivery can be prolonged over time, without the loss of mechanical stability. Silica-based mesoporous particles are particularly interesting as they retain their solid properties, present a large surface area, high loading capacity and stability, biocompatibility, controllable pore diameter and easy surface functionalisation.
Here the work has been devoted to the synthesis of MSNs with controlled pore size, in order to enhance their cargo capacity and with a properly engineered surface modified by grafting functionalities suited to i. increase the affinity to the loaded molecules, and ii. provide reactive anchoring points for binding stopper systems, responsive to the pH change stimulus able to acting as stimuli responsive valve.
Also, original hollow structures have been designed and realized as smart nanocarriers integrating a loading cavity with a mesoporous shell functionalized with grafting chemical groups suited to increase affinity with the loaded active compounds, as well as to release them under pH variation. Such structures can be particularly advantageous smart nanocarriers as, beside the porous structure, they also feature an additional reservoir, thus resulting able to longer sustain their function.
There prepared structures have been investigated by means of a thorough morphological and structural characterization, and loading and release test with model systems have been performed.

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