

## Novel nanomaterials for environmental and human health applications

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New nanotechnology approaches are playing a vital role in the solution of several human and environmental health-related issues. Non-invasive cancer imaging and therapy as well as efficient and cost-effective water cleaning represent significant challenges in these fields.

Due to their unique properties and versatility, adequately engineered nanomaterials are of crucial importance in such direction. Ultrasmall nanoparticles (sub-10 nm size), such as silicon nanoparticles (Si NPs) and carbon dots (CQDs), are growing in importance, especially in the imaging and therapy of cancer<sup>[1]</sup>. Titanium dioxide nanoparticles are not only being used as biocompatible materials, but have a key role in the photocatalytic wastewater cleaning<sup>[2]</sup>. Other nanoparticles, such as gold or silver ones, can be exploited in sensing and water cleaning applications thanks to their plasmonic properties.

Herein, we discuss the preparation, functionalization and application of different kinds of nanoparticles and nanocomposites for health and environmental care. In particular, we report on ultrasmall Si NPs and CQDs (size < 5 nm), modified with radiotracers for positron emission tomography imaging. The *in vivo* data demonstrate that these labelled particles are excreted rapidly from the body using the renal pathway, in contrast to bigger particles that show the tendency to accumulate in organs.

In the direction of the environmental applications, we report on titanium dioxide based nanocomposites for photocatalytic wastewater cleaning and adequately functionalized gold nanoparticles for metals sensing. In particular, titanium oxide nanocomposites are engineered to improve the efficiency of visible-light-driven photocatalysis for the cost-effective treatment of wastewater or to improve the post-recovery, while gold nanoparticles are modified with proteins from bacteria to achieve the sensing and, eventually, elimination of metals from water.

### References:

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