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Nanoparticles: Employment and detection in multiple applications and their fate in environmental cycles

Marilena Carbone

University of Rome Tor Vergata, Italy

Nanoparticles are being employed in several fields, due to the possibility of tuning their properties through the control of their size and coating. Electrochemistry, heterogeneous catalysis, biomedicine, food industry, cosmetics and tattoo inks production are all domains where nanoparticles play a role, thus encouraging even further development and use. The mainstream direction of progress is in shaping the nanoparticles in a target-oriented fashion, to entail a circumstantial use. In this frame line, nanoparticles for antibacterial use have been designed and synthesized with different strategies. Different metals in various ratios were used in mixed oxides to improve on the biocide properties. Encapsulated nanoparticles, or nanoparticles coordinating macrocycles may be employed to render tissues and clothes antibacterial. Ad hoc functionalization of gold nanoparticles was successfully employed to induce and enhance pH intracellular variations, with the purpose of making a cancer selective tool. An intriguing perspective is offered by the use of nanoparticles in tattoo inks, such as Fe_2O_3 , carbon black or TiO_2 , the latter largely used as whitening agent. Although, the aggregation of ink upon injection under the skin is still controversial, a correlation was found between nanoparticles size and cytotoxicity, along with the accumulation of the ink elements in regional lymph nodes, around the tattoos. The widespread use of nanoparticles poses several issues of safety, safety control and disposal in the environment, especially when nanoparticles accumulate or enter ecosystem cycles, thus inducing ecotoxicity.

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