Safe alternatives for the use of antibacterial nanoparticles

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Ag and TiO_2 nanoparticles (NPs) are well-known for their antimicrobial effect. Their use in commercial products is increasing and this raised the attention of the European Community on the nano-safety research on such materials [1]. In fact, dealing with antimicrobials always implies a basic cost-benefit evaluation of the balancing between toxicity for human and microorganisms. Ag and TiO_2 NPs are found as antibacterial additives in several every-day products and their application for producing auto-sanitizing textiles for healthcare is an interesting goal that could have a remarkable impact, especially if we think that they could be widely used in hospitals, where the higher-than-usual amount of bacteria meets an increased resistance to antibiotics. In this work we present coated Ag and TiO_2 NPs (Ag-HEC and TiO_2-SiO_2) as safe alternatives enabling the preservation of their antibacterial activity, but with a reduced toxicity with respect to their uncoated counterpart.

Ag-HEC is an innovative antibacterial hydrogel achieved by means of a green synthesis performed at room temperature and based on spherical Ag NPs (15-20 nm) capped with hydroxyethylcellulose (HEC). The outstanding potentialities of this patented process [2] stem from its low environmental impact combined with the absence of any kind of heating treatment. An excellent antimicrobial activity, revealed after testing Ag-HEC both against E. coli and against a pathogenic isolate of E. coli (strain CFT073), is coupled with a low cytotoxicity (strongly reduced with respect to the commercial AgNPs) assessed in presence of cell lines representative of human skin models.

TiO_2-SiO_2 core-shell NPs is the other promising material here presented as safe alternative and studied as antibacterial coating for textiles within the H2020 collaborative project Protect [3]. TiO_2-SiO_2 NPs have been prepared by means of a colloidal versatile heterocoagulation process [4], practical and easily transferable on large scale production which allows the surface covering of the active TiO_2 with the inert SiO_2 inorganic phase. The so-coated nanoparticles showed a decreased production of ROS, representing a positive response towards the reduction of potential hazard, and enhanced photocatalytic activity assessed in terms of deNOx performance due to the presence of SiO_2. In addition an optimal antibacterial activity seems to be preserved (tests are ongoing).

References

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4) S. Ortelli, C.A. Poland, G. Baldi, A.L. Costa, Silica matrix encapsulation as a strategy to control ROS production while preserving photoreactivity in nano-TiO_2, Environ. Sci.: Nano, 3 (2016) 602-610.