BSA-shell: a safe by design strategy to uniform and mitigate nanoparticles potential toxicity?

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Engineered nanoparticles (NP) are of major importance in novel technologies in different fields as catalysis, functionalization of surface, medical devices, sensors. Nevertheless, the already unsolved concerns on their potential toxicity, incite material scientists to look for safe-by-design (SbD) strategies that should let to the development of intrinsically safer nanophases. One of the most promising and reliable strategy is the control of NP surface coating, as recognised driver of NP biological pathways. Serum albumins are the most abundant proteins in the blood plasma and play an important role in the transport of various endogenous and exogenous ligands (Ferrado et al., 2019). The bovine serum albumin (BSA), having 76% homology with human serum albumin (HSA), has been regarded as a promising material in nanomedicine, because of its biological origin, biodegradability, nontoxicity, non-immunogenicity, water solubility and easy availability (An and Zhang, 2017; Elsadek and Kratz, 2012). The idea beyond this work is to apply a BSA coating on NP in order to uniform the surface reactivity and minimize biological impact of target NP, so they can expose the same biocompatible surface to biological compartments. In order to turn the idea in a sustainable SbD strategy, the proposed solution should comply with the following criteria: decreasing exposure and/or hazard potential, preserving nano-scale properties and satisfying production requirements, such as: cost-effectiveness, suitability for large-scale production, easy processing-line implementation for manufacturing nanostructured components. For this reason, we used the hetero-coagulation colloidal approach and play with surface charges to promote the interaction between NP surfaces and BSA and cover TiO_2 surface with BSA coating. We compared morphology, size distribution and zeta potential in buffer phosphate and estimated the hazard potential by measuring the OH radicals' production rate, using a chemical spin-trapping technique. We further investigated how the presence of BSA influenced the photoluminescence (PL) behaviours of the TiO_2 based samples and measured the photocatalytic reactivity vs the degradation of RhodamineB synthetic dye.

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