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Design and Development of Surface Modification and Synthesis Strategies to Reduce Toxicity of Nanoparticles

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The aim of the study is to develop new modification and synthesis strategies to reduce the toxicity of nanoparticles (NPs) used in ink and pigment industry. Zinc oxide (ZnO) NPs, quantum dots (QDs) and silver nanoparticles (AgNPs) were selected NPs due to their high toxicity. Biocompatibility, stability in ink formulation, chemical suitability, cost and applicability are the main requirements for the selection of the materials for surface modifications. Plasma proteins; bovine serum albumin, fibrinogen and apo-transferrin were chosen as surface modifiers for ZnO NPs and glucose was selected as a model carbohydrate for QDs to reduce toxicity. The covalent binding of surface modifiers on ZnO NPs and QDs was verified by spectroscopic and gravimetric techniques to demonstrate the success of surface coverage. A comprehensive evaluation of cellular toxicity of pristine and modified NPs demonstrated the surface modification of NPs decreased the toxicity influentially. A safety by design approach was developed to reduce toxicity of AgNPs through modifying synthesis conditions. The influence of synthesis conditions of AgNPs on size and toxicity was also investigated and the synthesis conditions were found as effective as the size dependent toxicity.

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