

Control of the Nanotoxicity of Polymer-Coated Titania Nanoparticles

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This study gives important insights of the various factors controlling the nanotoxicity of titania nanoparticles (TiO_2NPs). We studied the nanotoxicity of TiO_2NPs of various hydrodynamic diameters and crystallite sizes on *C. Reinhardtii* (microalgae) and *S. cerevisiae* (yeast) upon illumination with UV/visible light [1]. The cell viability was assessed for a range of nanoparticle concentrations and incubation times. Bare TiO_2NPs affect the microalgae viability at much lower particle concentrations than for yeast. We also found an increased nanotoxicity upon illumination with visible light which indicates that they may also interfere with the microalgae photosynthetic system leading to decreased chlorophyll content upon exposure to TiO_2NPs . The results indicate that the larger the hydrodynamic diameter of the TiO_2NPs the lower is their nanotoxicity, with anatase TiO_2NPs generally being more cytotoxic than rutile TiO_2NPs . We also prepared a range of polyelectrolyte-coated TiO_2NPs using the layer by-layer method and studied their nanotoxicity on yeast and microalgae. The toxicity of the coated TiO_2NPs alternates with their surface charge. TiO_2NPs coated with cationic polyelectrolyte as an outer layer exhibit much higher nanotoxicity than the ones with an outer layer of anionic polyelectrolyte. TEM images of sectioned microalgae and yeast cells exposed to different polyelectrolyte-coated TiO_2NPs confirmed the formation of a significant build-up of nanoparticles on the cell surface for bare- and cationic polyelectrolyte-coated TiO_2NPs . The effect is coming from the increased adhesion of cationic nanoparticles to the cell walls. Significantly, coating the TiO_2NPs with an anionic polyelectrolyte as an outer layer led to a reduced adhesion and much lower nanotoxicity due to electrostatic repulsion with the cell walls. This suggest a new way of making the TiO_2NPs potentially safer for use in different formulations by pre-coating them with anionic polyelectrolytes.

