

Sterilization of Microorganisms on Jet Spray Formed Titanium Dioxide Surfaces

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Abstract

The photocatalytic inactivation of microorganisms seeded on jet spray formed TiO₂ surfaces was studied using ultra-violet LED illumination centered at a wavelength of 388 nm. The surfaces were found to be highly effective at eradicating *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Candida albicans* cells, showing no obvious dependence on cell density. Efficiencies of killing were found to show a large variation between species with, in order of susceptibility, *P. aeruginosa* (gram-negative bacterium) > *S. aureus* (gram-positive bacterium) > *C. albicans* (yeast). A mechanism for inactivation based upon oxidation and reduction of cell membranes/walls by photo-generated OH radicals is supported. Those species with relatively thicker and complex cell wall structures (*C. albicans* and *S. aureus*) were destroyed more slowly than *P. aeruginosa*, which has a thinner cell wall. Electron microscopy examination showed complete mineralization of *P. aeruginosa* cells upon the TiO₂ surface within 25 minutes of illumination. The results presented illustrate the benefit that jet spray formed coatings could have upon the health service with examples including implants and sterile surfaces.
