Role of Surfactant on Ag/TiO_2 Nanoparticle Properties and Antimicrobial Effectiveness

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Photochemical synthesis of Ag-coated/TiO_2 nanoparticles with controlled particle size distribution and surface charge (zeta potential) has been identified as a pathway for the development of "self-cleaning" surfaces. The potential uses of such nanoparticles are quite extensive with applications ranging from antimicrobial paints to surface coatings for advanced medical devices and equipment. In order to harness the full potential of these nanocomposite materials, it is necessary to develop an efficient and robust synthetic process to control the desired particle properties. Furthermore, a correlation between the particle properties and the antimicrobial effectives is necessary. One major obstacle in the development of such nanomaterials is the ability to reduce particle aggregation, both during the reaction and post-reaction treatment steps. Commonly practiced synthetic processes result in severe particle aggregation during the photochemical reaction, producing particles well above 2000nm. Although these large particles do exhibit some antimicrobial properties, smaller particles are of significant importance because they can more readily diffuse through bacterial cell walls, resulting in greater antimicrobial efficiency. This research will focus on the effect of two surface modifying agents (surfactants), sodium dodecyl sulfate and PE1198, during the post-reaction treatment steps of Ag/TiO_2 nanoparticle synthesis to minimize aggregation. The introduction of these anionic surfactants will create a desired surface charge of approximately -30mV on the particles, which in previous studies has been shown to inhibit bacterial growth. Initial results reveal that the structure of the surfactant and the subsequent intermolecular forces present play a key role in both the reduction of the overall particle size and the modulation of the particles' zeta potential. SDS showed limited effect on the aggregation process while the addition of the alkyaryl phosphonic acid (PE1198) surfactant has allowed for the production of particles around 400nm in size. This presentation will address the modifications to the photochemical preparation of the nanoparticles to reduce aggregation as well as discuss the relationship between particle properties and antimicrobial effectiveness.

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