Nature Inspired Bactericidal Nanotextured Surfaces with ZnO Nanostructures

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The development of nosocomial infections arising from bacteria cross-transmission in clinical settings has led to an urgent need to promptly disinfect frequently touched surfaces, such as hand railings, door handles and elevator buttons. Conventional antibacterial disinfectants are not ideal as they contribute to the growing antibiotic resistance crisis. The use of a physical contact killing mechanism on nanotextured surfaces is a promising strategy for curbing the proliferation of bacteria, as these bactericidal surfaces do not lead to additional bacteria resistance formation. However, the existing methods of fabricating such surfaces are costly and unsustainable. My project addresses this gap by utilising wet oxidation to synthesize a novel bactericidal surface of ZnO hexagonal hollow nanotubes on Zn substrate. As only water and Zn are required in my one-step wet oxidation synthesis, these surfaces are (a) simple to produce, (b) durable, (c) low-cost and (d) environmentally friendly. After 6 hours of wet oxidation at 105 degrees Celsius, the surface demonstrated remarkable broad-spectrum bactericidal capabilities comparable to commercial surfaces, achieving complete killing within 2 h and 6 h for Escherichia coli and Staphylococcus aureus respectively. A dual killing mechanism consisting of physical contact killing, mimicking that of dragonfly (Orthetrum villosovittatum) wings, alongside superoxide (•O2^-) generation without photoirradiation is proposed to account for the bactericidal activity of WO-6. This highly bactericidal surface, capable of large-scale cost-effective fabrication, has the potential to be applied to frequently touched exteriors, medical implants and water filters to curb the rapid spread of pathogenic bacteria strains.

Awards Won:

Third Award of $1,000