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Development of a novel ZnO/PVC nanocomposite material for medical implant applications

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In hospitals and clinics worldwide, medical device surfaces have become a rapidly growing source of nosocomial infections. Contamination can occur from the presence of just a small number of microorganisms due to surgical procedure, improper sterilization, and more commonly the simple migration of bacteria from the skin into the body after an operation. Almost immediately after adhering to a device surface, bacteria can begin to form a biofilm: A robust, sticky matrix that provides protection against the host immune system and antibiotics. This makes the infection especially difficult to treat, and often necessitates device removal. Adding to the severity of this problem is the spread of bacterial genetic tolerance to antibiotics, in part demonstrated by the recent and significant increase in the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA).

Nanomaterials are beginning to be used for a wide variety of biomedical applications due to their unique surface properties which have the ability to control initial protein adsorption and subsequent cell behavior. This "nanoroughness" gives nanomaterials a greater functional surface area than conventional materials, which do not have significant features on the nanoscale. In addition, it is theorized that nanoparticles may also have general mechanisms of toxicity towards bacteria that do not cause problems for mammalian cells.

The objective of the present *in vitro* study was to reduce *S. aureus*density on conventional polyvinyl chloride (PVC) by embedding the polymer with zinc oxide nanoparticles through a simple and inexpensive procedure. The effect of nanoparticle size and %wtZnO was also investigated. The surface roughness and features of the ZnO/PVC nanocomposites were visualized using SEM. Results demonstrated that this technique significantly decreased bacterial density and biofilm formation without the incorporation of antibiotics or other pharmaceuticals, thus providing much promise for use in the manufacture of common implanted medical devices.

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