Zinc oxide nanoparticles for antimicrobial medical device coating and potential enzyme inhibition

Technology #6741

Nearly half of the two million hospital acquired infections are associated with the insertion of a medical device. These infections are caused by attachment and growth of bacteria on the medical device, leading to possible biofilm formation that can lead to a localized or even systemic infection. Medical device associated infections are the leading cause of hospital acquired blood infections. Treatment of these infections requires removal of the infected device and extensive antibiotic treatment, which is costly and leads to antibiotic resistance. Currently, medical devices are coated with antimicrobial coverings but with a continuance of high infection rates, improvements and more affective coverings are needed. This technology provides a synthesis technique of zinc oxide nanoparticles (ZnO NPs) that have antibacterial properties and can be applied to a variety of polymers for use as a medical device coating. This technology also has the ability to work as an enzyme inhibitor. Enzyme inhibitors are drug targets in nearly 47% of pharmaceutical drugs. These ZnO NPs resemble natural enzyme inhibitors but are not susceptible to denaturation or degradation allowing for a longer life span and more effective drug target. This technology has the potential to provide a better antibacterial coating for medical devices as well as a platform for the production of inorganic nanoparticle enzyme inhibitors.

Novel Method for Producing Zinc Oxide Nanoparticles With Specific Shapes and Antibacterial Properties

ZnO has been fairly extensively researched and found to have antibacterial properties. It is believed that the ZnO disrupts the bacterial cell membrane or creates reactive oxygen species. It is considered safe for humans and is often used in food production and storage as well as in sunscreen. This technology presents a novel mode of production for ZnO NPs and allows them to be synthesized in three different shapes (spheres, plates, or hexagonal pyramids). This technique allows their production without traditionally used capping and stabilizing agents which results in nearly chemically identical NPs that only differ in their desired shape. This technology demonstrates ZnO NPs ability to be fixed to a wide array of polymers often used in medical device development and have been found to decrease bacterial growth and biofilm formation. These ZnO NPs are a highly attractive alternative to current disinfectants and medical device coatings, which can be costly, especially when containing silver. Additionally, the control of the shape allows ZnO NPs to mimic enzyme inhibitors since their interaction with enzymes is highly shape dependent. Unlike traditional enzyme inhibitors, these inorganic NPs are not susceptible to denaturation or degradation as organic inhibitors would be. In contrast to other nanoparticles that have been tested as enzyme inhibitors, these ZnO NPs provide a reversible interaction and once removed, enzyme function is restored. This allows for a safe, controllable, and long lasting drug target that can be explored for an antibacterial drug or used as a platform to produce other inorganic enzyme inhibitors for differing diseases. Other nanoparticles contain silver or gold, which can be costly and other ZnO NPs are labor intensive to create. This technology provides a simple and cost effective method for the production of ZnO nanoparticles that have potential as both an enzyme inhibitor as well as an antimicrobial coating for medical devices.

Applications

- Antibacterial medical device coating
• Potential antibacterial drug
• Platform for production of inorganic enzyme inhibitors
• Research tool

Advantages

• Cost effective
• Simple production
• Multiple shapes but nearly identical chemistry
• Inorganic
• Long life span

Inventors

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