GOLD NANOPARTICLES ANCHORED ONTO POLYMER BRUSHES AS ROBUST ANTI-MICROBIAL SURFACES: A STRATEGY TO TACKLE AMR

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Antimicrobial resistance (AMR) is the capability of microorganisms, including bacteria, viruses, and fungi to withstand the impact of antimicrobial drugs. This resistance reduces the effectiveness of conventional medications, leading to the spread of infections and impacting modern surgery, chemotherapy, and organ transplantations. According to the WHO reports, 1.29 million global deaths were caused by AMR and this is projected to rise to 10 million deaths by 2050 if no actions are taken.[1] There are several ways to address antimicrobial resistance such as development of new drugs, public education, and responsible use of antibiotics. The latest report by UK Parliament has indicated that *less progress was made on reducing the number of drug-resistant infections*.[1] Another strategy to tackle this challenge is by designing antimicrobial surfaces that can inhibit the growth and survival of such microorganisms. These surfaces can be used as coatings on surgical trays, catheters, shower filters and surgical implants. The common materials utilised as antimicrobial surfaces include copper, silver, zinc, and titanium dioxide. However, leaching of these metal ions into the environment and low antimicrobial efficacy are major drawbacks associated with these materials. In this context, ultra-small gold nanoparticles (<1 nm in diameter) have gained significant attention as antimicrobial agents because of their inertness and production of reactive oxygen species (ROS), which destroy the bacterial cell wall.[2]

This study focuses on the development of stable antimicrobial surfaces by utilising the antimicrobial properties of gold nanoparticles and bacteriostatic properties of polymer brushes. Atomically precise gold nanoparticles of size ~ 0.8 nm are synthesised using a one pot strategy, and are subsequently attached to the polymer brushes that are tethered onto membrane surfaces.[3] The synthesised surfaces are characterised using multiple characterisation techniques including TEM, SEM, XPS, FT-IR ICP-OES, DR-UV/VIS and AFM. The stability of these surfaces is verified by performing different leaching tests replicating hospital settings. The antimicrobial efficacy of these surfaces is tested against *Escherichia coli* (E. coli), *Pseudomonas aeruginosa* (P. aeruginosa) and *Staphylococcus aureus* (S. aureus) bacteria. These bacterial strains are known for their increasing resistance to antibiotics and are frequent causes of infections in healthcare settings. The developed surfaces exhibit a 99.9%, 99.5%, and 99.9% reduction in *S. aureus*, *P. aeruginosa* and *E. coli,* respectively, within two hours of contact time. Furthermore, the effect of the size of gold nanoparticles, gold loadings and oxidation state on the antimicrobial properties is demonstrated. These synthesised antimicrobial surfaces demonstrate exceptionally high efficacy against bacteria, showcasing their potential for diverse biomedical applications including manufacturing water filters, coatings for surgical instruments, medical trays, and catheter.

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