ARRADIANCE ***Sneak Preview***

Atomic layer deposition of antibacterial ZnO on mesoporous silica

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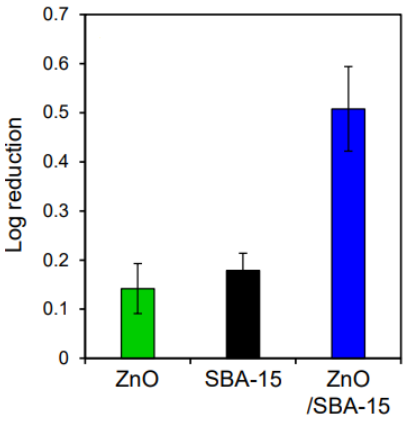
The emergence of antimicrobial-resistant (AMR) bacterial strains ("superbugs") such as *Staphylococcus aureus* ('MRSA'), *Escherichia coli* and *Salmonella* are a major threat to public health. By 2050, AMR will be responsible for 10 million deaths annually per year, with worldwide economic losses exceeding $1 trillion. Because AMR infections can occur from drinking contaminated water, numerous communities need low cost, scalable water treatment solutions, for example UV-photodegradation of bacteria, today.

Nanocomposites are attractive materials for water treatment because of their high surface area and tunable surface functionality. Ag and Cu metals and their oxides, as well as TiO_2 and ZnO show promise as either direct antimicrobial agents or by catalytically producing reactive oxygen species that destroy pathogens. Although ZnO nanostructures are potent antimicrobial agents, synthesising high surface area ZnO to maximise photocatalytic activity or Zn^{2+} dissolution rates remains challenging. In contrast, many routes exist to prepare high surface area silicas (> 500 m^2/g). The resulting ordered, porous silica scaffolds, such as SBA-15, have found extensive application as inert matrices to support Ag and ZnO antimicrobial nanostructures. New work by Australian researchers[1] explores ALD-synthesized ZnO on high surface area SBA-15, taking advantage of Arradiance's GemStar™ rotating particle coater and long exposure/soak mode, that allows precursors to infiltrate deep into powders and scaffolds.

The researchers used the drop plate count method to evaluate the antibacterial effectiveness of ZnO-SBA15 against *E. coli*.. This method counts colony-forming units (CFUs) of the bacteria after inoculation, incubation (with UV present, from 10 min to 1 hr) and series dilution. Antimicrobial efficacy and logarithmic reduction of CFUs before/after treatment were then calculated for SBA-15 alone, ZnO nanopowder, and ALD ZnO on SBA-15. ALD ZnO on SBA-15 significantly outperformed pure ZnO nanoparticles. Shorter UV exposures (10 - 30 min) showed very quick bacteriostatic action however maximum efficacy was achieved with exposures of 1 hr. Combining the high surface area of SBA-15 and antimicrobial activity of ZnO nanostructures creates a promising intervention against AMR contamination in water systems.



Arradiance enables easy coating of difficult-to-handle powders with a particle rotation canister and flexible deposition modes. For more information on Arradiance™ Technology, ALD systems or Foundry services, please contact Arradiance.

1. Merenda, Andrea and Gangadoo, Sheeana and Johannessen, Bernt and Wilson, Karen and Chapman, James and Lee, Adam F., Atomic Layer Deposition of Antibacterial ZnO Monolayers Over SBA-15. Materials Today Chemistry, http://dx.doi.org/10.2139/ssrn.5084056