Layer-by-Layer decoration of AgNPs with Aminocellulose and Quorum Quenching Acylase for Controlling Bacterial Pathogens and Their Biofilms

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The emergence of drug resistant bacteria and the failure of the existing therapeutics call for development novel antibacterial strategies. Furthermore, the inclusion of pathogens in highly organized biofilms causes difficult to treat infections and lead to poor treatment outcomes.[1,2,3 4] Whereas, the existing antimicrobials and the host immune response can eradicate the planktonic bacterial cells, they become inefficient once the cells establish biofilm structures that restrict the penetration of the antimicrobials. The process of biofilm formation is upon the phenomenon of cell-to-cell communication, known as quorum sensing (QS).

Targeting QS systems in the pathogens is an emerging area of research due to the capability of the anti-QS agents to attenuate bacterial virulence and biofilm formation, making the cells more susceptible to the conventional drugs at lower concentrations. Interfering with bacterial QS may potentiate efficacy of the current antimicrobials lowering the risk of development of resistance.
Herein, we developed novel safe-by-design hybrid nano-entities of silver nanoparticles (AgNPs) decorated with layers of bactericidal aminocellulose (AC) and QS interfering enzyme acylase in a Layer-by-Layer (LbL) fashion. The AC and acylase nanoshell enhanced the antibacterial activity of the AgNPs core towards the common Gram-negative pathogen *Pseudomonas aeruginosa*, lowering their minimum inhibitory concertation by 4-fold and prevented and eradicated the established biofilms with 8-fold lower AgNPs concentration. These nano-sized hybrid entities were able to inhibit QS process by 45% and eliminated the drug resistant biofilms of *P. aeruginosa* from a model surface (Figure 1). Moreover, the surface modification of the AgNPs improved its biocompatibility and did not affect the viability the morphology of human fibroblast cells. In border context, the developed novel NPs could be a promising alternative to combat difficult-to-treat bacterial infections, without creating selective pressure for resistance development.

References

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Figures

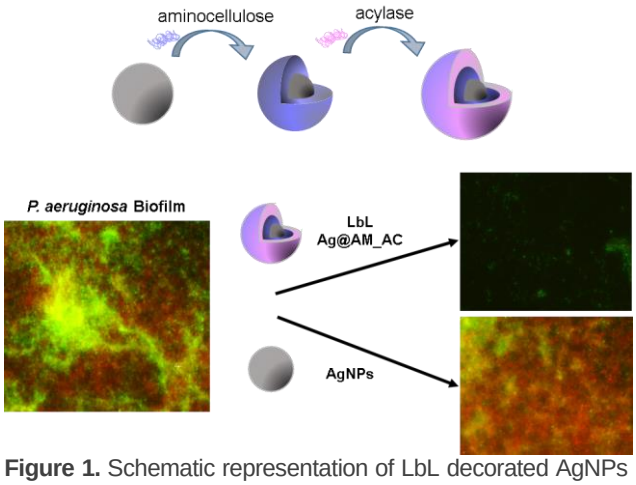

Figure 1. Schematic representation of LbL decorated AgNPs and their exposure to mature biofilms