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The Platinum-Enhanced Activity of Antibacterial Silver

Silver (Ag) has valuable antibacterial and purifying properties, and for centuries was used to keep potable liquids pure. It has also been used in many medical applications, ranging from wound dressings to attacking Legionnaires' disease. Its antibacterial activity depends on the balance between the activity of Ag^+ ions, which kill the bacteria, and the total amount of Ag released from a coating. If the amount of Ag released is too high, cytotoxicity will result. The released Ag^+ ions act by displacing other essential metal ions, such as those of calcium or zinc, from biological material. In order to enhance the antibacterial performance of Ag, it is necessary to increase the concentration of Ag^+ ions relative to that of metallic Ag released from the coating.

Researchers from Enterprise Ireland, and Biomatech in France, have now investigated whether platinum (Pt) could enhance the release of Ag^+ ions from antibacterial Ag coatings (D. P. Dowling, A. J. Betts, C. Pope, M. L. McConnell, R. Eloy and M. N. Arnaud, *Surf. Coat. Technol.*, 2003, **163–164**, 637–640). As Ag is more active than Pt in the galvanic (electrochemical) series, Pt should enhance Ag^+ ion formation through galvanic action. To evaluate this, chronoamperometric experiments were performed on Ag-Pt alloys (0.5 and 3.0% Pt) in pH 8.00 borax buffer solutions containing 0.02 mol l^{-1} HCl at 20 ± 2°C. Resulting current-time curves showed that Ag^+ formation increased with Pt addition by up to 100%.

Antibacterial Ag and Ag/Pt coatings were deposited onto a range of polyurethane and silicone polymers using a combination of magnetron sputtering and neutral atom beam plasma sources. The magnetron sputtering target was prepared from 1% Pt in a Ag matrix; this sputtered Ag/Pt coatings with thicknesses in the range 5–12 nm.

The bacterial adhesion and bactericidal effects of the Ag and Ag/Pt coated polymers were tested using *Staphylococcus epidermidis*, and the cytotoxicity was tested using fibroblast cells. Adding 1% Pt significantly enhanced the antibacterial effectiveness of the Ag coatings. For silicone, which has highly mobile polymer chains, up to a 2 log reduction in bacterial adhesion was achieved for 5 nm thick Ag/1% Pt coatings. Cytotoxicity was not observed.