ENGINEERING OF ELECTROACTIVE BACTERIAL CELLULOSE-CARBON NANOTUBE BANDAGES FOR TREATMENT OF *STAPHYLOCOCCUS AUREUS*

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I developed bandages that act like chemical reactors to rapidly resolve antibiotic-resistant infections.

Abstract

Staphylococcus aureus hospitalizes over 320,000 people yearly, is becoming increasingly resistant to antibiotics like vancomycin, and can stop wounds from healing. In this study, bacterial cellulose-carbon nanotube (BC-CNT) bandages were engineered to produce electrochemical species, which rapidly eliminated vancomycin-intermediate *S. aureus*. To create the bandages, the bacteria *K. sucrofermentans* was cultured to synthesize a BC membrane. Then, CNTs—one of the most electrically conductive materials at room temperature—were integrated into decellularized BC. This created stable and electrically conductive BC-CNT bandages. The electrical properties were then modeled and used to design circuitry throughout the bandages. When *S. aureus* was exposed to the electrified bandages for just an hour, its biofilm-forming capacity decreased by over 91% and displayed increased antibiotic susceptibility. This effect was most prominent in areas of reduced pH, implying that the electric signals generate antimicrobial compounds and disrupt transcellular charge gradients that underpin *S. aureus* homeostasis. These results advance applications of electrochemistry in medicine and create a new direction to overcome antibiotic-resistant infections.