Development of a Novel Antimicrobial Polymer for Biomedical Applications

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Infections due to polymers in implants (catheters, prosthetics, etc.) remain a constant threat to public health, as implant-derived infections make up 50% of all nosocomial infections and cost over $4 billion annually. One reason for this is the lack of an effective antimicrobial polymer. A novel coating process is described that simply and inexpensively allows a polymer to be coated with copper nanoparticles, resulting in the creation of an antimicrobial polymer. The polymer polydimethylsiloxane (PDMS) was synthesized and irradiated at 254 nm (Hg), causing the generation of carboxylic groups on the surface of the polymer. After irradiation, the PDMS was dipped into a copper acetate solution, allowing copper to attach to the functional groups on the polymer's surface. The presence of copper on the polymer was verified by infrared spectroscopy. Irradiation time was varied, and a methylene blue test was used to quantify the amount of copper on the surface of the PDMS for different times. A dose-response curve was constructed to determine optimum irradiation time with an R2 value of 98.7%. Copper nanoparticles of 10, 50, and 100 nm were assayed against HaCaT cells, yielding viability rates of 99%, indicating that such concentrations of copper were had no negligible effect on human cells. The antimicrobial properties of the treated polymer were tested with E. coli and S. epidermidis, and bacterial growth on the coated polymer was found to be significantly lower than that of the control (99.7% decrease). This coating serves as an inexpensive method of eliminating bacterial growth on polymers, suitable for a variety of biomedical applications. Therefore, these findings will help to combat bacterial infections and save lives.