556f Chemical Vapor Deposition of Antimicrobial Polymer Coatings

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Thin coatings of antimicrobial polymers have been synthesized by initiated CVD (iCVD) and can be applied to a wide range of substrates, including fragile materials that are sensitive to heat and/or solvents. This makes iCVD ideal for imparting antimicrobial properties to fabrics and medical devices/implants. Antimicrobial fabrics are of interest in military applications, such as biowarfare protection, self-decontaminating fabrics, undergarments for long term use on deployment, as well as civilian uses such as clothing for athletes and hikers, and textiles in hospital environments, including bedding, draping, and scrubs. Microbial contamination of medical devices is a major concern; it has been estimated that 250,000 blood stream infections result from central venous catheters yearly in the US. Existing strategies for imparting antimicrobial properties to surfaces commonly employ an antimicrobial agent, such as silver ions or antibiotic drugs, which leaches out from the bulk material. However, the time of effectiveness will be limited as the agent will eventually be exhausted. The most prevalent non-leaching strategy is to permanently bond cationic quaternary ammonium polymers to the surface through covalent attachment. This work seeks to build on this non-leaching strategy by depositing a styrene-derivative polymer which contains a tertiary amino group with a pKa near 10 so that it is protonated to a cationic state at physiological conditions. The structure of the deposited polymer was confirmed by FTIR and the coating surface and thickness was imaged by SEM. Coated samples of dyed nylon fabric were tested according to ASTM E2149-01. An iCVD coating of 39 μg/cm2 fabric (corresponding to a thickness of ~40 nm on the fiber) was effective at killing E. coli; a 99.99% (4 log) reduction in viable bacteria was observed in just two minutes and a 99.9999% (6 log) reduction was observed in one hour. In addition, post-test sonication of coated samples have shown no viable bacteria adhered. The coating has also been successfully tested against the gram positive bacterium S. epidermidis. Initial demonstration of an all-vapor-phase covalent grafting scheme of the iCVD polymers to nylon was achieved using the type II photinitiator benzophenone.