ALD Applications
Room On Demand - Session AA15

Emerging: Medical/Healthcare/Pharmaceuticals

AA15-1 Atomic Layer Deposition of Nanocomposite Antimicrobial and Antiviral Coatings*, Anil Mane, M. Gros, R. Wilton, S. Forrester, Y. Zhang, . Zaluzec, D. Schabacker, S. Darling , J. Elam,* Argonne National Laboratory, USA

Antimicrobial (AB) and antiviral (AV) coatings can play a crucial role in health and safety by preventing the growth and spread of pathogens. Based on the chemical composition of these coatings can drastically reduce or even kill the bacterial and viruses via surface chemical reaction, catalytic reaction activated by light, thermal treatment, in presence of reactive gases or surface functional groups.Antimicrobial and antiviral-coated surfaces are becoming more broadly examined for possible use in areas such as medical clothing and equipment, surfaces encountered in public and private transportation and household use. The most common and most significant use of antimicrobial/antiviral coatings has been used in healthcare in the manufacture of masks and equipment to prevent hospital related infections, which have accounted for more than a million deaths worldwide. In addition, the current pandemic caused by the SARS-CoV-2 virus has infected more than 100 millon people resulting in over 2.2 million deaths from COVID-19. Therefore, it is essential to develop effective antimicrobial and antiviral coatings to address a wide range of needs.

Antimicrobial/viral coatings can be prepared using a variety of thin film coating processes. A thin coating can be applied to a surface that has a chemical composition which is toxic to microorganisms but not to humans. Among the various coatings, layers containing Cu and Ag have been shown particularly effective against microorganisms and viruses. In addition, other coatings such as TiO_2, ZnO and MoO_3 have also shown antimicrobial/antiviral properties. Due to outstanding processing advantages, we have evaluated atomic layer deposition (ALD) as a viable approach for the commercial production of AB/AV coatings.In this study, we prepared a wide variety of ALD materials including binary, ternary, and quaternary oxides and composites on N95 mask filter materials (polypropylene) and polyester fabrics at temperatures as low as 50^{o}C. All of these ALD materials showed uniform and conformal coatings that infiltrated the porous fabrics. We tested the antibacterial and antiviral properties of these ALD coated materials and identified coating formulations that were highly effective against bacteria and viruses. Moreover, the coatings did not diminish the filtration properties of the N95 mask filters.In this presentation we will discuss the coating materials, the AB/AV testing results and future directions. We think that the technology present here can be used for other air filter applications.

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