INTEGRATION OF SILVER NANOPARTICLE POLYMER NANOCOMPOSITES AND 3D PRINTING TECHNOLOGIES FOR DURABLE ANTIMICROBIAL COVERS

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Efforts to combat microorganisms focus on surface modification and antimicrobial coatings, emphasizing the direct application of biocidal substances without affecting bulk properties. Advances in antimicrobial materials involve polymer-solvent-active material composites [1], resulting in varied antimicrobial effects. 3D scanning and printing enable the creation of intricate, flexible coatings [2], suitable for frequently touched surfaces to reduce the spread of microorganisms and pathogens. In this work, AgNP synthesized through photochemical methods [3] are combined with a PVB polymer matrix to create a silver nanoparticles - polymer nanocomposite (AgNP-PVB). This nanocomposite is applied as a thin-film coating on customized protective covers produced using 3D scanning and printing. An algorithm developed in Matlab reconstructs the 3D model. To assess the antiviral effect, 10-well substrates are 3D printed, with 8 wells filled with the test solution for 24 hours. The 9th and 10th wells were maintained as controls, and after 24 hours, the same test solution was added to them before PCR analysis. At 500 ppm AgNP concentration, the antiviral assay showed a test well cycle threshold (Ct) value of 30.78 ± 2.00, while the control well had a Ct value of 25.92 ± 0.04. At 200 ppm, the test well Ct value was 28.22 ± 0.88, and the control well had a Ct value of 24.65 ± 0.40. The coating's Ct values were akin to the 200 ppm control wells, with a test value of 25.27 ± 1.41 and a control value of 24.61 ± 0.11, indicating that even the Flexible 80A polymer itself possesses antiviral properties. The work conducted pilot 3D printing to apply tested coatings on various objects, choosing a door handle cover as a frequently touched item. Using a 3D model obtained through scanning, the cover was reconstructed with a developed algorithm. This research contributes to durable antiviral coatings, addressing the prevention of infectious disease transmission in various environments.

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