

## Multifunctional Polydopamine-Silver-Polydopamine Nanofilm With Applications in Digital Microfluidics and SERS

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**Abstract :** Polydopamine (PDA) is a popular material in biological and medical applications due to its excellent biocompatibility, outstanding physicochemical properties, and facile fabrication. In this project, a new sandwich-structured PDA and silver (Ag) hybrid material named PDA-Ag-PDA was synthesized and characterized layer-by-layer, where silver nanoparticles (Ag NPs) are wrapped in PDA coatings, using SEM, AFM, 3D surface metrology, and contact angle meter. The silver loading capacity is positively proportional to the roughness value of the initial PDA film. This designed film was subsequently integrated within a digital microfluidic (DMF) platform coupling with an oxygen sensor layer for on-chip antibacterial assay. The concentration of *E. coli* was quantified on DMF by real-time monitoring oxygen consumption during *E. coli* growth with the optical oxygen sensor layer. The PDA-Ag-PDA coating shows a 99.9% reduction in *E. coli* population under non-nutritive condition with 1-hour treatment and has a strong growth inhibition of *E. coli* in nutrient LB broth as well. Furthermore, PDA-Ag-PDA film maintaining a low cytotoxicity effect to human cells. After treating with PDA-Ag-PDA film for 24 hours, 82% HEK 293 and 86% HeLa cells were viable. The SERS enhancement factor of PDA-Ag-PDA is estimated to be  $1.9 \times 10^4$  using Rhodamine 6G (R6G). Multifunctional PDA-Ag-PDA coating provides an alternative platform to conjugate biomolecules and perform biological applications on DMF, in particular, for the adhesive protein and cell study.

**Keywords :** polydopamine, silver nanoparticles, digital microfluidic, optical sensor, antimicrobial assay, SERS

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