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Biopolymer-Templated Deposition of Hierarchical 3D-Structured Graphene Oxide/Gold Nanoparticle Hybrids for Surface-Enhanced Raman Scattering

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Cellulose, a well-known natural biopolymer, possesses numerous advantages such as cost-effectiveness, renewability, ease of processing, and biodegradability [1]. Due to these inherent merits, cellulose has emerged as a promising bio-based substrate capable of synergistically combining with conductive materials (e.g., metals or carbon-based materials) for diverse applications including sensors, smart windows, and bioelectronics [2]. Typically, Surface Enhanced Raman Scattering (SERS), an advantageous analytical technique, allows for the rapid detection and structural analysis of biological/chemical compounds through their spectral patterns in nanotechnology [3]. Crucial for SERS is fabricating the substrates with strong enhancements of the Raman signal over large areas and with a low fabrication cost. Herein, we present a straightforward approach utilizing the layer-by-layer (LBL) spray coating method to fabricate cellulose nanofibrils (CNF) films loaded with gold nanoparticles and Graphene Oxide to serve as SERS substrates. To gain comprehensive insights into the nanostructuring evolution, advanced X-ray scattering techniques, grazing incidence small-angle X-ray scattering was employed to investigate the fundamental mechanisms. Thereby, our approach provides a reference for facile and scalable production of universally adaptable SERS substrates. This research opens up new avenues for achieving high-performance electronic materials in a more sustainable manner.

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