

Supplementary Information

Simultaneous Enhancement of Raman Scattering and Fluorescence Emission on the Graphene Quantum Dots-Spiky Magnetoplasmonic Supra-particles Composite Films

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Preparation of Au NPs

The large Au NPs were synthesized according to Bastus's method [3]. First, an Au seed solution was prepared by injecting 1 mL of a HAuCl₄ solution (25 mM) into a boiling aqueous solution of sodium citrate (150 mL, 2.2 mM) under continuous stirring. Immediately after the synthesis of the Au seed solution (150 mL), the reaction mixture was cooled in the same reaction vessel until a temperature of 90 °C was reached. Then, 1 mL of the HAuCl₄ solution (25 mM) was injected into the reaction solution. After 30 min, the reaction was complete. This process was repeated

twice. The sample was then diluted by extracting 55 mL of the reaction solution and adding 53 mL of DI water and 2 mL of a 60 mM sodium citrate solution. This solution was then used as the Au seed solution, and the process was repeated twice. By changing the volume extracted at each growth step, the seed particle concentration could be controlled.

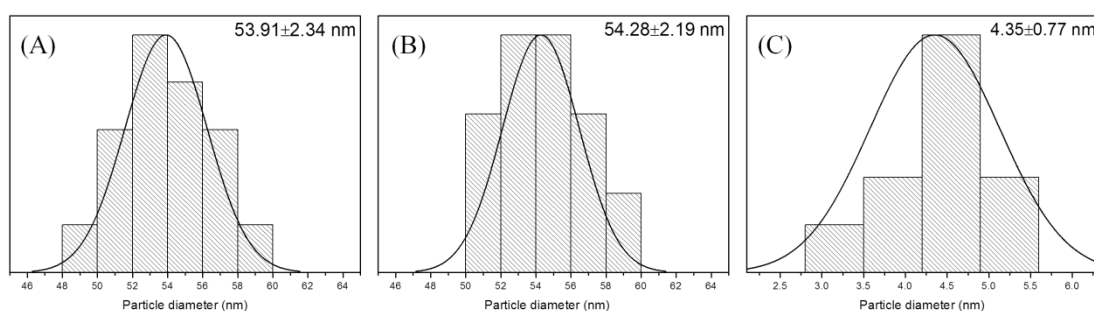


Figure S1. Particle-size distributions of the (A) spherical Au NPs, (B) spiky $\text{Fe}_3\text{O}_4@$ Au SPs, and (C) GQDs.

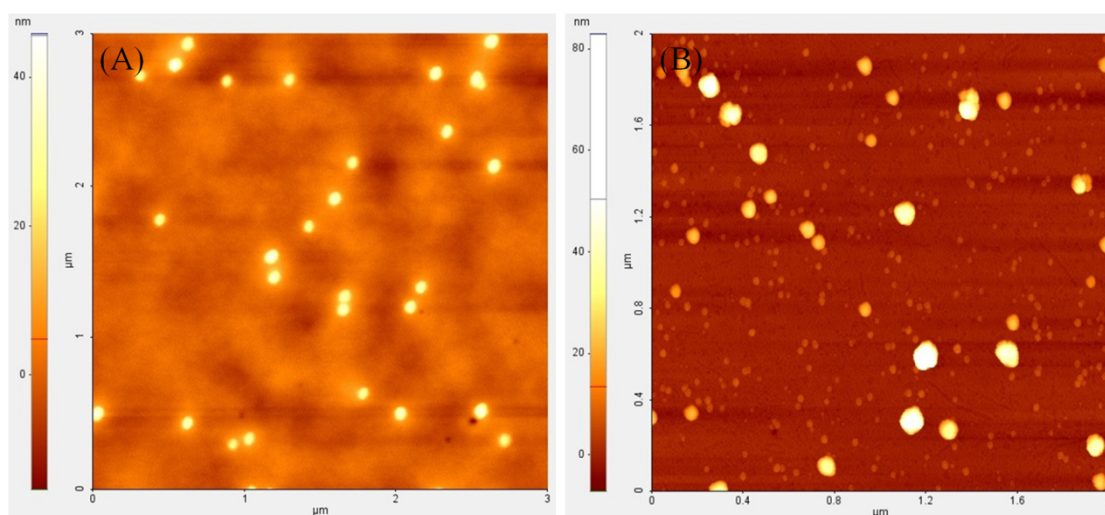


Figure S2. The AFM images of (A) GQD-spherical Au NP, and (B) GQD-spiky $\text{Fe}_3\text{O}_4@$ Au SP composite films

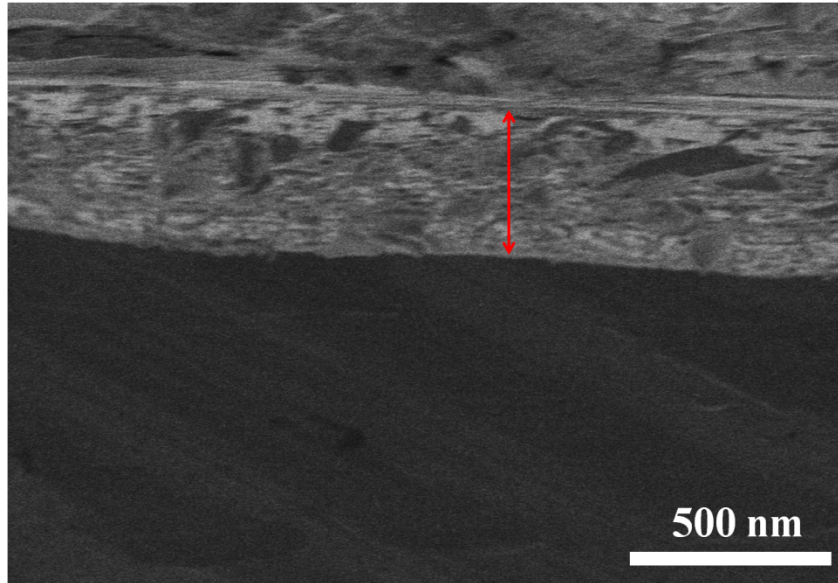


Fig. S3. The SEM image of the cross section of (PDDA/PAA)₁₀ LbL multilayer films