Graphical Abstract

This study focuses on the core problem of how to separate, enrich and detect probiotics in complex food matrix directly and quickly for the first time, and innovatively proposes and constructs a SERS signal double amplification strategy based on the synergistic effect of a interface self-assembled gold nanoparticle array (GNA) and Fe_3O_4@PDA@AgNPs, which is applied to the rapid and highly sensitive detection of probiotics in complex food matrix. Firstly, a dense and uniform AuNPs film was constructed on a solid support using interfacial self-assembly technology to serve as the SERS substrate. Secondly, a multifunctional magnetic core-shell nanoprobe, Fe_3O_4@PDA@AgNPs, was designed and synthesized to possess both magnetic separation/enrichment functions and excellent SERS activity. Spatially, a sophisticated "AuNPs–AgNPs" multi-coupling structure was formed, enabling rapid separation and enrichment of probiotics as well as dual amplification of SERS signals. This is expected to break through the bottlenecks of insufficient sensitivity and weak anti-interference ability encountered in conventional SERS methods for probiotic detection.