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## Plasmonic filter paper substrates coated with antibacterial silver nanoparticles for the identification of trace Salmonella

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## Abstract

Salmonella is a common type of Gram-negative bacteria that is found in many food sources and can not only survive but also easily grow under unfavorable environmental conditions. Therefore, controlling Salmonella bacteria in agriculture, food, and processing industries is always a challenging issue, and the identification and detection of very small amounts of it are of great importance. Surface-enhanced Raman spectroscopy (SERS) has emerged as a reliable and accurate method for rapidly detecting small quantities of biological and chemical substances. In this study, a SERS biosensor was developed by utilizing a filter paper (FP) substrate that was coated with silver nanoparticles (AgNPs). The AgNPs were synthesized through a chemical reduction process and underwent characterization using DLS, UV-Vis, TEM, and FE-SEM. By coating the FP substrate with AgNPs, active plasmonic sites were created, enabling the detection of Salmonella molecular vibrations (MVs). When the FP substrate was exposed to Salmonella, an interaction occurred between the bacteria and the AgNPs, facilitating the identification of extremely low amounts of Salmonella. Additionally, the antibacterial properties of the AgNPs were observed. The SERS FP substrate exhibited the capability to detect Salmonella at concentrations as low as 10<sup>1</sup> CFU. Experimental measurements were conducted to obtain the Raman spectra and peak signals, and the reproducibility of the substrates was confirmed. The empirically calculated enhancement factor for identifying the Salmonella MVs was determined to be  $1.448 \times 10^5$ ; while, a numerical estimation yielded a value of  $3.740 \times 10^5$ .

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