Proc. of the Intl. Conf. on Nanotechnology for Better Living, 2016
Editors K. K. Kar, A. Shah and R. Sharma
Vol. 3, No. 1, p. 333
doi:10.3850/978-981-09-7519-7nbl16-rps-333

Fast detection of pathogenic bacteria using biosynthesized silver nanoparticles as SERS substrate

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Surface-enhanced Raman scattering (SERS) spectroscopy is advantageous due to the large enhancement of weak Raman signal and thereby emerged as a powerful tool to identify pathogens. However, it is difficult to fabricate homogeneous SERS active substrate in bio-sensing application to obtain uniform, stable and highly reproducible SERS signal. Nonetheless, recently we reported the biosynthesis of silver nanoparticles using leaf extract of *Neolamarckia cadamba* and its use as SERS active substrate to detect bacteria within a very short time of 1-5 sec with a limit of detection (LOD) of 10^3 CFU/ml (CFU = colony-forming unit) for *E. coli* [1].

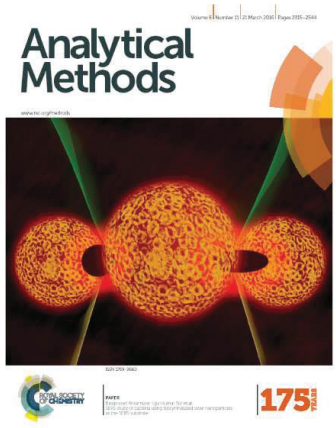

Figure 1: Our Cover Art Image published by The Royal Society of Chemistry (RSC), United Kingdom [1]

Herein, we discuss a novel application of the SERS technique for rapid detection (1-5 sec) and quantification of bacteria based SERS signals at the interface of bacteria trapped between Ag NPS (Figure 1) on our newly developed almost homogeneous SERS-active substrate giving highly reproducible, stable and uniform Raman signal with large enhancement factor and almost zero fluctuation, especially useful for the analysis of slow-growing bacteria.

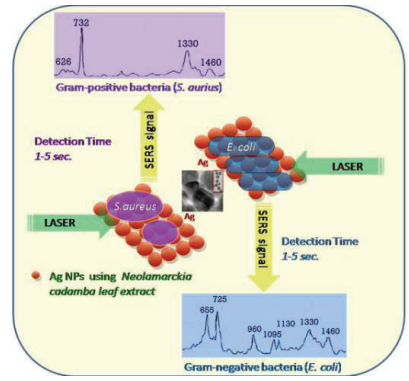

Figure 2: SERS spectra of (a) gram-positive bacteria (*Staphylococcus aureus)* and (b) gram-negative bacteria (*E. coli*) using Ag NPs as SERS substrate

The SERS signals obtained from gram-positive bacteria (*S. aureus)* and gram-negative bacteria (*E. coli*) (Figure 2) can be exploited for fast detection (1-5 sec) of these bacteria. However this robust, fast detection method can be extended for other pathogens detected from blood, saliva and urine sample of the patients (Figure 3).

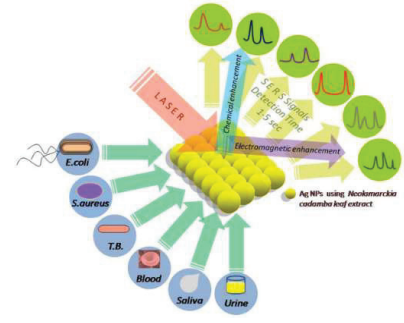

Figure 3: Schematic depicting SERS signals emerged from the interface of pathogens from various sources and Ag NPs as SERS substrate

Reference

1. B. Ankamwar, Ujjal Kumar Sur and P. Das *Anal. Methods*, Vol. 8, pp. 2335-2340 (2016).