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Plasmonic Enhancement Enabled by Silver Nanotriangles in Raman Spectra of Methylene Blue

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Abstract

We present a method for detecting Methylene Blue (MB) using Confocal Raman Spectroscopy assisted with plasmonic enhancement from colloidal silver nanotriangles (NTs). The amplified Raman signal from the analyte aggregated over nanoclusters facilitated the detection of concentrations below 10^{-5} M.

Methylene blue and silver NTs were mixed in equal proportions and a thin film of the solution was drop casted on a glass slide for collecting Raman data. Raman signals were acquired from the plasmonic hotspots (PHs) present in the sample, using 532 nm laser excitation. PHs in the sample were identified as dark blue spots, as seen under confocal microscope. These PHs were formed by the adsorption of dye on aggregated NTs and give a stronger signal because of localised surface plasmon resonance (LSPR). The triangular morphology contributed to a better enhancement due to the lightning rod effect [1]. From experimental data, it is inferred that the limit of detection was well below the concentration reached, 0.25×10^{-5} M.

Fig. 1: Schematic of experimental setup. Laser is focussed on nanoclusters with dye adsorbed on.

The main challenge to be addressed is the repeatability of the technique owing to the non-uniform and unstable hotspots scattered throughout the colloid. The reliability of this method can be increased with appropriate modification of the drop casting method to achieve a more uniform film. Considering the ease of implementation and cost-effectiveness, colloidal silver NTs are promising substrates in Surface Enhanced Raman Spectroscopy.

Keywords: Plasmonic enhancement, silver nanotriangles, plasmonic hotspots, LSPR.

References:

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