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Label Free Detection of Small Molecules Using Surface-Enhanced Raman Spectroscopy with Gold Nanoparticles Synthesized with Various Capping Agents

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Abstract : Surface-Enhanced Raman Spectroscopy (SERS) has received increased attention in recent years, focusing on biological and medical applications due to its great sensitivity as well as molecular specificity. In the context of biological samples, there are generally two methodologies for SERS based applications: label-free detection and the use of SERS tags. The necessity of tagging can make the process slower and limits the use for real life. Label-free detection offers the advantage that it reports direct spectroscopic evidence associated with the target molecule rather than the label. Reproducible, highly monodisperse gold nanoparticles (Au NPs) were synthesized using a relatively facile seed-mediated growth method. Different capping agents (TRIS, citrate, and CTAB) were used during synthesis, and characterization was performed. They were then mixed with different analyte solutions before drop-casting onto a glass slide prior to Raman measurements to see which NPs displayed the highest SERS activity as well as their stability. A host of different analytes were tested, both non-biomolecules and biomolecules, which were all successfully detected using this method at concentrations as low as 10-3M with salicylic acid reaching a detection limit in the nanomolar range. SERS was also performed on samples with a mixture of analytes present, whereby peaks from both target molecules were distinctly observed. This is a fast and effective rapid way of testing samples and offers potential applications in the biomedical field as a tool for diagnostic and treatment purposes.

Keywords : gold nanoparticles, label free, seed-mediated growth, SERS
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