SERS based detection of nanoplastics in drinking water through the use of salt induced nanoparticle aggregation

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Abstract

The omnipresence of micro and nano plastics is a worldwide growing concern that has increased following recent research published on their harmful effects on the ecosystem and itsliving organisms Although significant work has already been done on detection of microplastics, there is an undeniable need for further developments in analytical techniques for the detection and identification of nanoplastics. Here, a simple analytical technique based on surface enhanced Raman spectroscopy through the use of gold nanoparticles as a substrate which enables the successful detection of 100 nm diameter polystyrene beads through salt assisted aggregation of the nanoparticles is reported. The gold nanoparticles are synthesized using the Turkevich method which involves the use of sodium citrate as both reducing and stabilizing agent that leaves them very stable due to the surrounding negative charge on their surfaces. However, upon the addition of the sodium chloride solution, the ions present in the solution disturb the negative charge consequently reducing the energy barrier to an aggregation of the nanoparticles around the polystyrene beads. The controlled aggregation of the nanoparticles was used to shift the plasmon resonance peak for optimal SERS signal demonstrating an efficient detection for a low concentration of nanoplastics. Through this technique, a concentration of nanoplastics as low as 1 part per million was detected, which to the best of the author's knowledge is the lowest concentration of nanoplastics of that size or smaller that has been detected by a simple technique. With these experiments having been performed with deionized water, the reproducibility of the technique was then demonstrated by quantifying the recovery rate for spiked drinking water samples.

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