Public Abstract
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Title:NOVEL APPROACHES TO CHARACTERIZE ENGINEERED NANOPARTICLES IN CONSUMER PRODUCTS AND BIONANOMATERIALS BY SURFACE-ENHANCED RAMAN SPECTROSCOPY

There has been increasing number of consumer and food products sold on the market that contain various engineered nanomaterials (ENMs) such as silver nanoparticles (AgNPs) and gold nanoparticles (AuNPs). These nanomaterials possess novel physical and chemical properties that can be used for wide applications in agriculture and food safety. However, these ENMs can damage human and animals' health and current analytical methods to detect and measure ENMs are time-consuming, labor-intensive, and expensive. The objective of this study was to develop a novel, simple, rapid, and accurate method to detect AgNPs and AuNPs in consumer products using surface-enhanced Raman spectroscopy (SERS). SERS measurement was conducted to detect AgNPs and AuNPs using an effective Raman indicator, 4-aminothiophenol (pATP). The pATP can strongly bind with nanoparticles, generating greatly enhanced Raman signals that can be used for measurement. The pATP was combined with Ag or Au stock solutions, AgNO3, citrate-coated AgNPs, citrate-coated AuNPs, AuCl, AgNPs, AuNPs, and five commercial products to study the differences in their SERS spectral data. The observed spectra of AgNPs and AuNPs have similar peaks at ~390, ~1087, and ~1590 cm-1 that can be attributed to the C-S stretching vibration, C-C stretching vibration, and C-H stretching vibration, respectively. Neutron activation analysis (NAA) and electron microscopy was used to characterize and quantify AgNPs and AuNPs in the consumer products. The results demonstrate that SERS method in combination with NAA can be an effective method for detection of ENMs, and it can easily distinguish AgNPs and AuNPs from other non-nanoparticle species in the complex matrices.

A nanocomposite based on cellulose nanofibers (CNFs) coated with silver nanoparticles (AgNPs) was developed in this study as a flexible, effective, and biocompatible substrate for use in surface-enhanced Raman spectroscopy (SERS) analysis. An effective Raman indicator molecule, 4-aminothiophenol (pATP), was used to characterize AgNPs impregnated on CNFs. The CNF-AgNP films were used in SERS analysis to detect thiabendazole (TBZ) pesticides in apples. The influence of pH on the SERS spectra of TBZ was investigated because TBZ is a neutral molecule that has a low affinity to AgNPs. The pH of TBZ solution was decreased to below the TBZ's pKa, thus enable the electrostatic attraction between TBZ and AgNPs. The CNF-AgNP nanocomposites are acid-resistant, chemically stable, and in three dimensional scaffold structure. CNFs can prevent the uncontrolled aggregation of AgNPs in low pH environment and be used as an effective AgNP/nanocellulose platform for SERS analysis. Results of this study demonstrate that CNF-AgNP nanocomposites can be used to rapidly detect TBZ and other neutral molecules and pesticides in various food products.