

SERS screening method for substances adsorbed on solid surfaces: examples with pesticide residues

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Objective

Recently, surface-enhanced Raman spectroscopy (SERS) is increasingly used by researchers because substances can be investigated nondestructively or *in situ*. In Raman spectroscopy, a target substance is irradiated with an excitation light and SERS is used to enhance the signal intensity, and the intrinsic wavelength of the substance can be measured. We are aiming to fabricate substrates by bonding dense noble metal nanostructures on a flexible adhesive tape surface in a robust manner. We have succeeded in fabricating a substrate called FlexiSERS that satisfies the following two requirements: 1) the surface must be flexible enough to follow the contour of an uneven object to be measured, and 2) the nanostructures must not peel off easily [1]. We report an example of its application to the measurement of pesticide residues on the surface of agricultural crops.

Methods

First, silica nanoparticles were adsorbed onto a glass slide and then transferred onto a double-sided adhesive tape affixed to the top of a pin. Ag was then vacuum deposited onto the tape to create FlexiSERS substrates. After that, two operations were carried out; a method of measuring a Raman spectrum by placing the reagent in a Petri dish and immersing the substrate directly into it, or by immersing crop peels in the reagent and pressing them against the peels. The important requirements for the fabrication condition of FlexiSERS is selection of appropriate adhesive tape, particle size, and silver film thickness. Therefore, we optimized the fabrication condition by comparing combinations of eight different adhesive tapes, three different particle types, and deposition thicknesses (20, 100 nm).

Result

As a result, ferbam's spectra were extremely enhanced with nanospheres with 400 nm diameter but decreased for nanospheres with 100 or 700 nm diameter. We transferred the silica nanoparticles by pressing a piece of tape during substrate fabrication. Upon comparison of various adhesive tapes, we found out that a significant difference in peak intensity was observed among these tapes. The material and surface condition of the adhesive tape itself affect the particles transferred. It was found that selecting an adhesive tape with relatively strong adhesion and little unevenness on the tape surface leads to good FlexiSERS. We optimized the pressing conditions for this process. In order to improve the condition of the substrate surface, a weight of about 30 g is optimal for pressing on the sliding glass.

Reference:

[1] J. Chen, Y. Huang, P. Kannan, L. Zhang, Z. Lin, J. Zhang, T. Chen, and L. Guo. *Anal. Chem.*, **88**, 2149 (2016).