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Au@ZIF-8 SERS Paper for Food Spoilage Detection

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Abstract

Putrescine and cadaverine are important volatile indicators for the evaluation of food spoilage. In this study, a metal-organic framework (MOF)-coated surface-enhanced Raman scattering (SERS) paper platform for the detection of putrescine and cadaverine is developed. Au@ zeolite imidazolate framework-8 (ZIF-8) SERS paper is fabricated by the coating of ZIF-8 layer on a Au nanoparticle-impregnated paper that is prepared by dry plasma reduction. The Au@ZIF-8 SERS paper is characterized by scanning electron microscope, energy-dispersive X-ray spectroscopy, X-ray diffraction, and N₂ sorption isotherm. The ZIF-8 layer enables the accumulation of gaseous molecules and also provides enhancement of SERS signals. The fluorescence, SERS, and simulation results prove the improved detection ability of the Au@ZIF-8 platform for the volatile molecules. For the selective detection of putrescine and cadaverine, the Au@ZIF-8 SERS paper is functionalized with 4-mercatobenzaldehyde (4-MBA). The 4-MBA molecule acts as a Raman reporter and also a specific receptor for the volatile amine molecules. Using the intensity ratiometric detection of 4-MBA-functionalized Au@ZIF-8 SERS paper, putrescine and cadaverine are quantitatively detected with detection limits of 76.99 and 115.88 parts per billion, respectively. Furthermore, the detection of volatile amine molecules released from spoiled salmon, chicken, beef, and pork samples is demonstrated. It is anticipated that the MOF-coated SERS paper platforms will be applicable not only in food safety but other applications including disease diagnosis and environmental monitoring.

논문정보

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