**Flexible membrane-based substrate for SERS detection of malathion**

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Flexible SERS substrates for highly sensitive detection of toxic compounds in the food safety field are a highly demanded area of research. The potential of such substrates is due to the ease of fabrication and the porous non-planar structure, which contributes to the efficient generation of hot spots in a wide spectral range. In this study, a simple and flexible membrane-based substrate for SERS sensing of malathion is proposed. Malathion is one of the most common organophosphate pesticides used in pest control. Pesticide residues on crops can cause harmful effects on the central and peripheral nervous system when ingested. Therefore, the relevance of the development of reliable, selective, and sensitive methods for the detection of malathion is obvious. The SERS substrate was fabricated by in situ synthesis of silver nanostructures on the cellulose fiber membrane using a conventional silver mirror reaction with further growth of silver raspberry-like nanoparticles on the substrate surface. The performance of the prepared SERS substrate was tested for 4-mercaptobenzoic acid (MBA) detection and revealed a detection limit of 1.5 ng/mL. Then, the membrane-based flexible substrate was employed for SERS to detect malathion. The analysis of Raman intense peak at 1035 cm-1 allowed to estimate the sensitivity of the malathion detection at the sub-µg/mL range, which is significantly below the regulatory requirements for its maximum residue levels. Therefore, the proposed flexible membrane-based substrate demonstrates the potential for simple SERS detection of malathion for food safety.

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