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PII: S0039-9140(18)30115-2
DOI: https://doi.org/10.1016/j.talanta.2018.02.014
Reference: TAL18333

To appear in: *Talanta*

Received date: 20 November 2017
Revised date: 1 February 2018
Accepted date: 4 February 2018

Cite this article as: S. Fateixa, M. Raposo, H.I.S. Nogueira and T. Trindade, A general strategy to prepare SERS active filter membranes for extraction and detection of pesticides in water, *Talanta,* https://doi.org/10.1016/j.talanta.2018.02.014

# A general strategy to prepare SERS active filter membranes for extraction and detection of pesticides in water

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## Abstract

An important feature in the fabrication of surface-enhanced Raman scattering (SERS) platforms is, together with the high efficiency, to allow the rapid collection and analysis of a vestigial analyte. Conventional substrates based on rigid solid materials or metal hydrosols are not suitable for sample extraction, limiting their application in areas such as water quality monitoring. Herein, we have developed a strategy to fabricate SERS active substrates (Ag/LCP) based on liquid-crystal polymer (LCP) textile fibers decorated with Ag nanoparticles (NPs). Two distinct methods for substrate preparation envisaging the SERS detection of the pesticide thiram have been explored in this research. In a first stage, we have investigated the usefulness of both approaches using ethanolic solutions of the pesticide thiram, and after real samples spiked with thiram were used to explore the analysis in real environment. The SERS analysis of thiram dissolved in Aveiro Estuary water and in fruit juices have provided enhancement factors of $1.67\times10^7$ and $3.86\times10^5$, respectively, using the Ag/LCP composites. Noteworthy, in the latter case, the detection limit (0.024 ppm) achieved is lower than the maximal residue limit (MRL) of 5 ppm in fruit, as prescribed by European regulations (EU) 2016/1. Moreover, the selectivity of the SERS substrates for different pesticides was also evaluated, analyzing distinct pesticides such as paraquat and sodium diethyldithiocarbamate. SERS active Ag/LCP/PA filter membranes were also prepared using Ag/LCP composites supported by a polyamide (PA) filter, which can be an easy alternative to prepare simple, highly efficient and low-cost SERS active filter membranes for water analysis.

Graphical abstract