Nanoplasmonic Paper Substrate for Identification of Chemical and Biochemical Analytes in a Complex Matrix

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Technology description

Overview

The rapidly growing crisis of synthetic opioid abuse has become an urgent public health and safety issue. Synthetic opioids are extremely potent (e.g. fentanyl is 50-100 times more potent than morphine). They readily enter brain tissue, and silently place law enforcement at risk. The current on-site detection of opioids is not sensitive or specific. Thus, a new on-site detector allowing safe collection and accurate identification of suspicious substances is urgently needed.

Technology

A disposable multi-functional cartridge allows sample collection, separation, and enhanced detection in a single portable device. This cartridge contains an organic solvent reservoir and a nanoplasmonic paper, called “nanopaper”. This nanopaper provides multiple functions. First, it serves as a vacuum filter paper; thus, traces of illicit drugs (aerosolized or deposited on floors and other surfaces) could be collected on the nanopaper using a commercial vacuum cleaner. Second, it serves as a stationary phase for paper chromatography in which drugs are separated from complex ingredients to improve the detection specificity. Third, the nanoparticles on the nanopaper permit surface-enhanced Raman spectroscopy (SERS), providing a 106~108-fold enhancement of Raman signals over commercial Raman detectors. The cartridge can be easily installed in commercial handheld vacuum cleaners and Raman detectors; thus, it can immediately benefit a wide range of forensic applications and threat chemical detections.

Application area

Law enforcement: on-site detection of fentanyl and other opioids.

Homeland security: monitoring explosives and threat chemicals.

Industrial safety: chemical hazard monitor.

Forensic applications.

Advantages

Cost: < $0.06 per test.
No need to label cells for concentrating inside the droplet
Processing time: < 1min.
Specificity: detecting < 0.1wt% of the target chemical mixed with garden soil.
Sensitivity: 106~108-fold more sensitive than commercial opioid Raman detectors.
Minimizes risk of fentanyl exposure and human error during material collection and transfer.
Can detect opioids mixed with complex ingredients.
Cartridge is a simple add-on to existing technologies.
Can be adapted to commercial remote-control devices.
Can also detect other opioids, explosives, and threat chemicals.

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