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Flexible and sustainable plant-wearable sensors for on-site and fast decentralized pesticide detection toward precision agriculture and food safety

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Highlights

Simple method for fabrication of flexible, biocompatible and biodegradable sensors. Plant-wearable sensor can detect carbendazim and paraquat directly on lettuce and tomato skin for food safety.

Resumo/Abstract

On-site monitoring the presence of pesticides on crops and food samples is essential for precision and post-harvest agriculture, which demands nondestructive analytical methods for rapid, low-cost detection that is not achievable with gold standard methods. The synergy between eco-friendly substrates and printed devices may lead to wearable sensors for decentralized analysis of pesticides in precision agriculture. In this paper we report on a wearable non-enzymatic electrochemical sensor capable of detecting carbamate and bipyridinium pesticides on the surface of agricultural and food samples. The low-cost devices (<US$ 0.08 per unit) contained three-electrode systems deposited via screen-printing technology (SPE) on solution-blow spinning mats of poly (lactic acid) (PLA). The flexible PLA/SPE sensors can be used on flat, curved and irregular surfaces of leaves, vegetables and fruits. Detection was performed using differential pulse voltammetry and square wave voltammetry with detection limits of 43 and 57 nM for carbendazim and diquat, respectively. The wearable non-enzymatic sensor can discriminate and quantify carbendazim and diquat on apple and cabbage skins with no interference from other pesticides. The use of such wearable sensors may be extended to other agrochemicals, including with incorporation of active bio (sensing) layers for online monitoring of any type of agricultural products and foods.

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