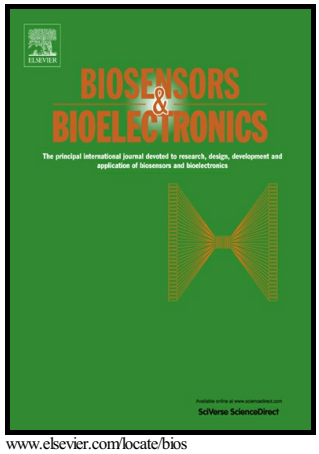

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Detection of Vapor-Phase Organophosphate Threats Using Wearable Conformable Integrated Epidermal and Textile Wireless Biosensor Systems

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Abstract

Flexible epidermal tattoo and textile-based electrochemical biosensors have been developed for vapor-phase detection of organophosphorus (OP) nerve agents. These new wearable sensors, based on stretchable organophosphorus hydrolase (OPH) enzyme electrodes, are coupled with a fully integrated conformal flexible electronic interface that offers rapid and selective square-wave voltammetric detection of OP vapor threats and wireless data transmission to a mobile device. The epidermal tattoo and textile sensors display a good reproducibility (with RSD of 2.5 and 4.2%, respectively), along with good discrimination against potential interferences and linearity over the 90 to 300 mg/L range, with a sensitivity of 10.7 $\mu A \cdot cm^3 \cdot mg^{-1}$ (R^2 0.983) and detection limit of 12 mg/L in terms of OP air density. Stress-enduring inks, used for printing the electrode transducers, ensure resilience against mechanical deformations associated with textile and skin-based on-body sensing operations. Theoretical simulations are used to estimate the OP air density over the sensor surface. These fully integrated wearable wireless tattoo and textile-based nerve-agent vapor biosensor systems offer considerable promise for rapid warning