Textile Based Sensor for Food and Biomedical Analysis

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Abstract

This doctoral thesis addresses the need for rapid, on-site analysis tools for detecting contaminants and biomarkers in food and biological samples. The research focuses on the design, fabrication, and validation of innovative 2D disposable textile stochastic sensors, developed using nanotechnology and cold plasma deposition techniques, to ensure precise and reliable assessments in food quality and biomedical diagnostics. The main objective is the creation of flexible, cost-effective sensing strips integrated onto textile substrates, primarily silk fabric, enabling direct analysis without extensive sample preparation. A key innovation lies in the uniform plasma deposition of carbon–copper nanocomposites, which provide stability and selectivity in detecting analytes such as ochratoxin A in milk and wine, patulin in apple juice, and hepatitis C virus antigens in blood. Experimental results demonstrate that plasma-deposited nanolayers significantly enhance sensor sensitivity and reproducibility. The sensors achieved accurate chronoamperometric measurements and maintained reliability during real-world testing, including in supermarket environments. The outcomes contribute to advancing rapid diagnostic technologies, offering scalable fabrication processes for portable, disposable sensors. Their potential extends to food safety, healthcare, and environmental monitoring, supporting improved public health and quality control practices worldwide.