Modified Nanoporous Gold Sensor for the Electrochemical Detection of Acetaminophen

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Acetaminophen is a molecule commonly taken medicinally, yet also can present dangers due to overdosage and environmental contamination. To address these concerns, accurate detection of acetaminophen is critical. Many established methods for acetaminophen determination, although highly precise, are slow and inefficient. Electrochemical sensing is a newer alternative. This method consists of monitoring the change in electric current through a conductive electrode as a chemical oxidation or reduction reaction occurs. This project investigated an electrochemical approach to compare the sensing ability for acetaminophen using two types of electrodes: bare nanoporous gold wire and nanoporous gold wire with immobilized thiolated beta-cyclodextrin. The electrodes were fabricated through an electrochemical deposition and chemical dealloying process. Cyclic voltammetry scans of acetaminophen at 10, 50 and 100 micromolar concentrations were taken for both types of electrodes. The modified nanoporous gold resulted in sharper and more defined electrochemical peaks as well as a stronger peak current vs. concentration relationship (Correlation: $r = 0.610$, $p = 0.010$; ANOVA regression: $F=7.219$, $p=0.020$, $R2=0.373$) in comparison to the bare nanoporous gold electrode. Thus, the beta-cyclodextrin surface modification enhanced the electrochemical sensing method's ability to detect and quantify acetaminophen. The method holds promise for development and incorporation into rapid-testing devices to monitor acetaminophen for medical diagnostics and environmental testing purposes.

Awards Won:
Fourth Award of $500
American Chemical Society: Third Award of $2,000