A Novel Approach to Fabricate Screen-Printed Electrode on The Composite of Gold Nanorods-Graphene Oxide for Detection of Uric Acid

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Abstract

In this work, we report the development of a technique to fabricate a screen-printed electrode (SPE) and its applications for uric acid sensing. The SPE was fabricated using a printing technique using an office printer printed on a photo paper substrate. Particularly, the conductive ink used for printing the working electrode (WE) and counter electrode (CE) consisted of graphene oxide (GO) and gold nanorod (AuNR) material. While the reference electrode (RE) was made by applying the conductive silver paste to the fabricated SPE. The electrochemical measurement of uric acid solution using fabricated SPE GO/AuNR provides a higher signal than the commercially available SPE. The electroanalytical performance of the fabricated SPE based on GO/AuNR toward the measurement of uric acid solution exhibited a linear range of 0.8–200 μM, a detection limit of 0.5 μM, a quantitation limit of 1.0 μM, outstanding repeatability (% relative standard deviation) of 4.885 % as well as good selectivity with ascorbic acid, dopamine, glucose, urea, and sodium as interference. Furthermore, the fabricated SPE based on GO/AuNR was successfully employed for the determination of uric acid concentration in human urine samples using the standard addition approach.

Introduction and Experimental

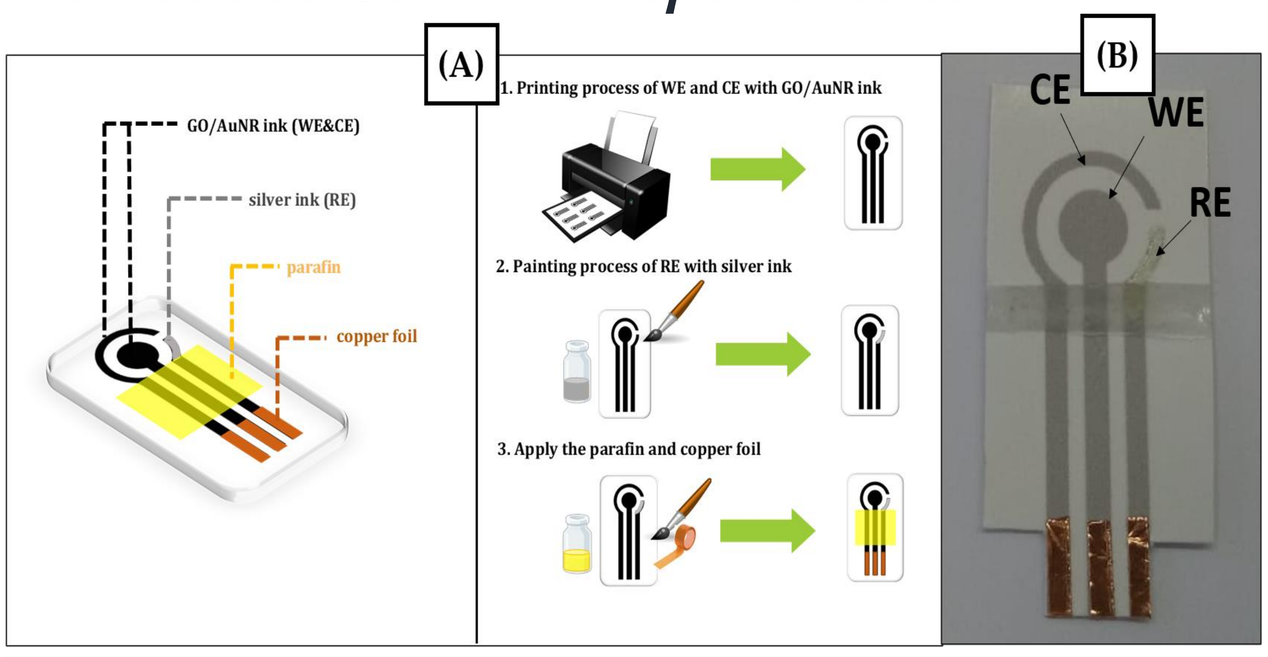

Figure 1. (A) Schematic illustration of the fabrication process of SPE based on GO/AuNR using inkjet-printing technique, (B) the result of the fabricated SPE with inkjet-printing technique.

Results and Discussion

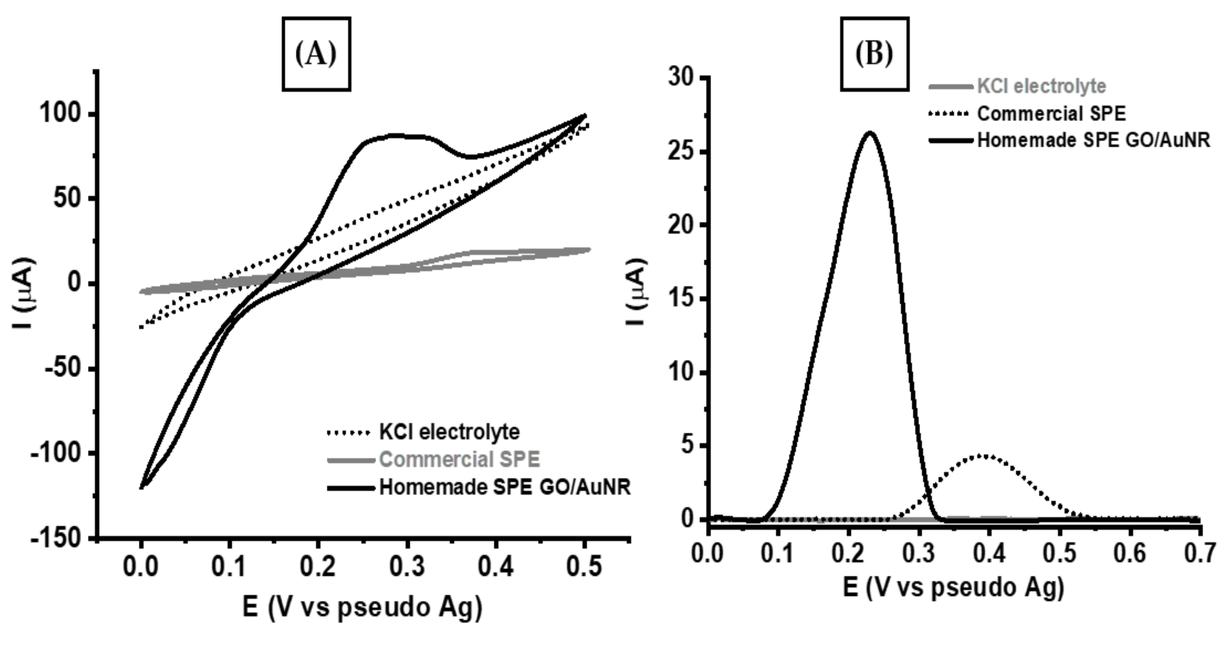

Figure 2. Voltammograms were obtained from (A) CV and (B) DPV techniques for the measurements of 0.2 mM uric acid in 0.1 M KCl using commercial SPCE and SPE based-GO/AuNR.

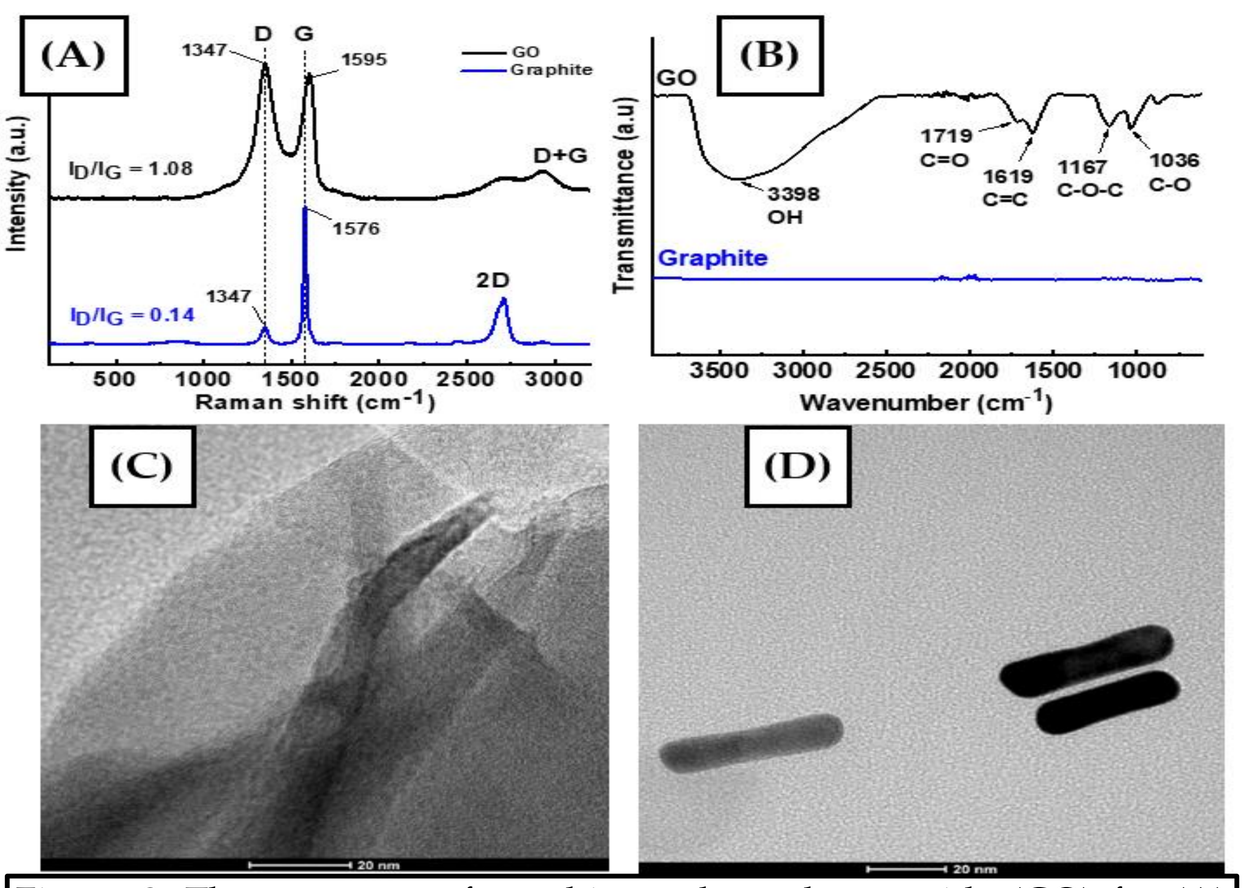

Figure 3. The spectrum of graphite and graphene oxide (GO) for (A) Raman and (B) FT-IR, TEM images for (C) GO, and (D) gold nanorod (AuNR).

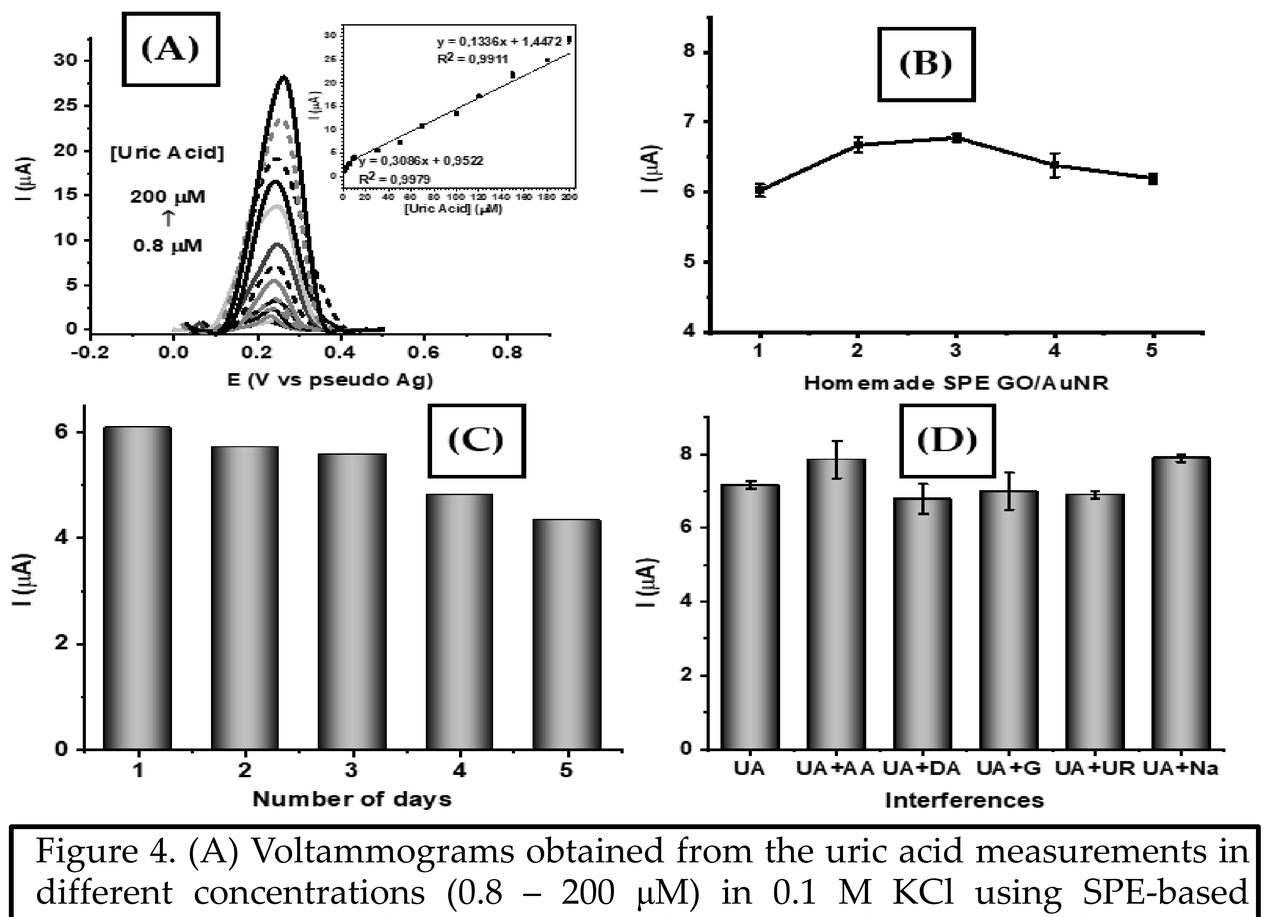

Figure 4. (A) Voltammograms obtained from the uric acid measurements in different concentrations (0.8 – 200 μM) in 0.1 M KCl using SPE-based GO/AuNR. Inset: the linear regression between peak current with uric acid concentration, (B) Reproducibility of uric acid measurements of 50 μM using five different electrodes, (C) Stability of uric acid measurements at a concentration of 50 μM over 5 days consecutive days, (D) Variation of response current in the uric acid measurement in the presence of several interferences such as ascorbic acid (AA), dopamine (DA), glucose (G), urea (UR), and sodium (Na) when measured with SPE-based GO/AuNR.

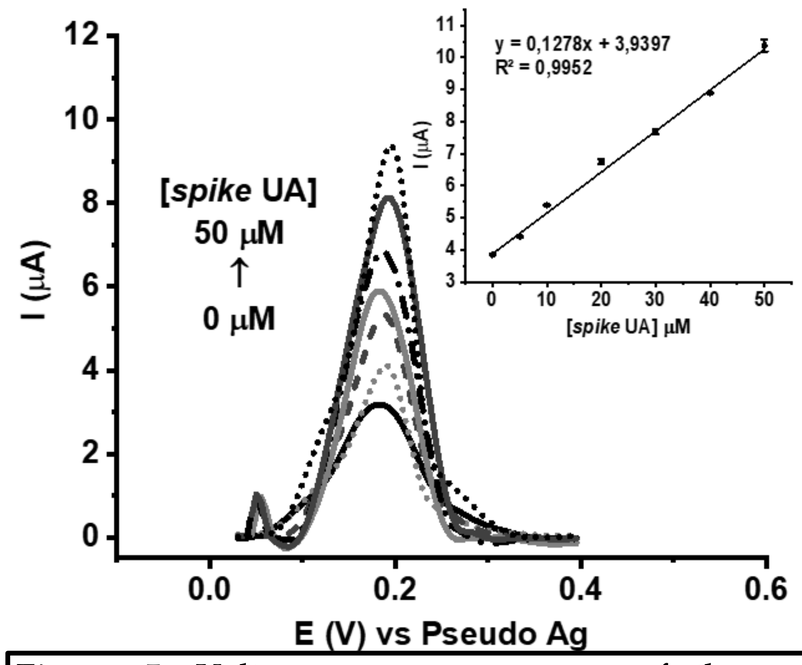

Figure 5. Voltammogram response of the sample of human urine spiked with increasing concentration of uric acid (0 – 50 μM) in 0.1 M KCl measured using SPE-based GO/AuNR. The inset is the resulting calibration plot.

Electrode	Linear range (μM)	LOD (μM)	LOQ (μM)
Co-N/Zn@NPC	0.1 – 14.7	5×10^{-4}	1.6×10^{-3}
PCL/PEI/UOx/QD	5 – 52.0	3.96	13.1
Poly(DPA)SiO_2@Fe_3O_4	1.2 – 1.8	0.4	1.2
Chi/Gox/PB-G	10 – 30	0.11	0.38
OXL-9	40 – 120	1.4	4.7
ErGO/PEDOT:PSS	10 – 100	1.08	3.61
rGO/AuNPs	10 – 500	3.6	10.95
MC-GO-Fe_3O_4	0.5 – 140	0.17	0.5
GO/AuNR	0.8 – 200	0.5	1.0

Future Work

- ✓ Enhance its sensitivity for uric acid detection employing novel and conductive materials