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Supplementary material

for

A novel approach for non-enzymatic determination of urea via screen-printed electrode prepared with conductive ink containing graphene and nickel oxide

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Reagents, solutions, and apparatus

Dopamine hydrochloride (98%), graphite (<20 µm), xanthan gum, potassium hydroxide (85%), sodium chloride (99.99%), sodium sulfur nonahydrate (≥99.0%), sodium bicarbonate (≥99.7%), sodium phosphate monobasic (≥99.7%), sodium phosphate monobasic (≥99%), calcium chloride hexahydrate (≥95%), ammonium chloride (≥99.5%), potassium chloride (≥99.0%), nitric acid, uric acid, urea (≥99.5%), nickel (II) nitrate hexahydrate (≥99.5%), glucose and lactic acid (80%) were supplied by Sigma-Aldrich. The sodium hydroxide propanoate (98%) was provided by AmBeed. The dihydrogen phosphate (98%), calcium chloride dihydrate, ethanol (≥99.9%), and potassium dipotassium hydrogen phosphate (98%) were supplied by Merck.

A phosphate buffer solution (PBS) was made using potassium dihydrogen phosphate and dipotassium hydrogen phosphate solutions. Ultrapure water, obtained from pure water devices suitable for the Milli-Q system (Direct-Q & Direct-Q UV), was used in the preparation of all solutions. Silver ink (Electrofix) and the SPE connector required for measurements are purchased from an electronic equipment supplier. The paper used as a substrate to produce the screen-printed electrodes, and the adhesive paper used as a mask, were obtained from a local store**.**

The synthesis products were dried using a Memmert brand oven and the SPE annealing process was performed with this oven. An ATX224 analytical balance from SHIMADZU was used for all weighing procedures. An electronic cutter (Silhouette Cameo 4) was used to prepare the handmade electrodes, and the necessary templates were cut out on adhesive paper. Fourier Transform Infrared (FTIR) spectroscopy was carried out using a Spectrum One instrument from Perkin Elmer. FE-SEM analyses were carried out using a Zeiss EVO® LS 10 scanning electron microscope. X-ray Photoelectron Spectrometry was carried out using a Thermo Scientific K-Alpha. The Autolab PGSTAT 128N device was employed for all electrochemical measurements, while the Gamry Reference 3000 Potentiostat/Galvanostat device was utilized for electrochemical impedance measurements and N-Gr synthesis. Ultrasonic bath Bandelin Sonorex (RK 255 H) was used to reduce particle sizes.

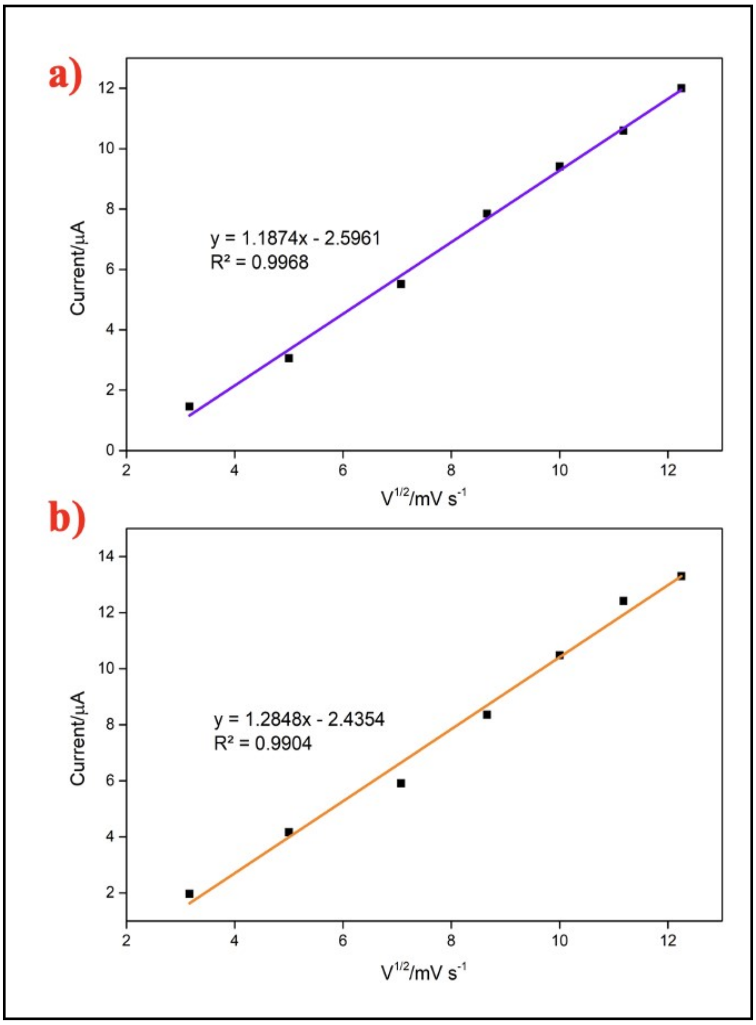

Fig. S1 Graph showing $\nu^{1/2}$ - Ip relationship for different scan rate with (a) G/SPE, (b) G/NiO/N-Gr/SPE.

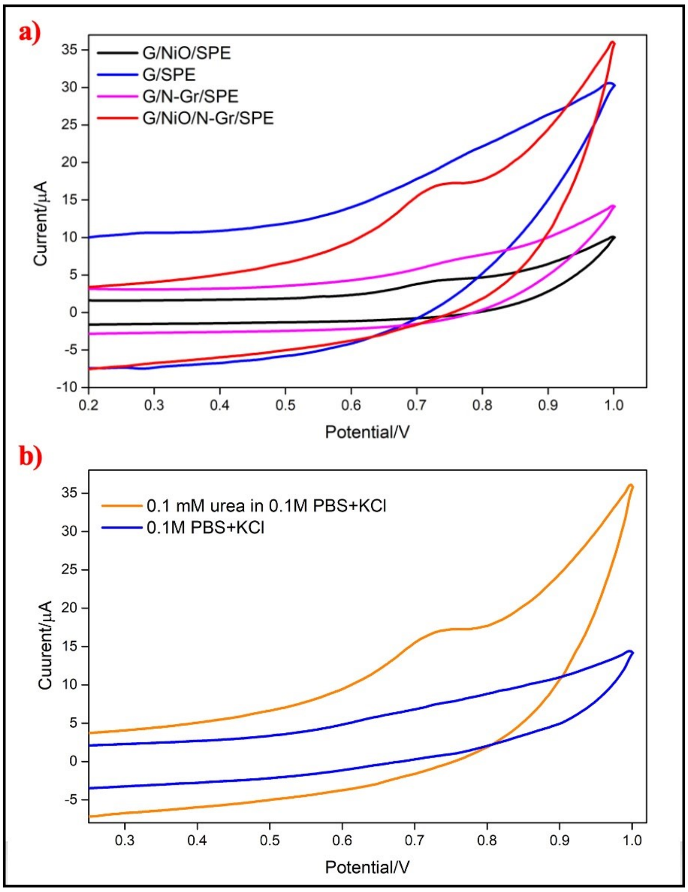

Fig. S2 (a) Comparison of the G, G/N-Gr, G/NiO, and G/NiO/N-Gr/SPEs with CV in 0.1 mM urea (0.1 M PBS + KCl pH 7.40) at a scan rate of 50 mv s^{-1} (b) CVs of G/NiO/N-Gr/SPE at a scan rate of 50 mv s^{-1} with and without urea.

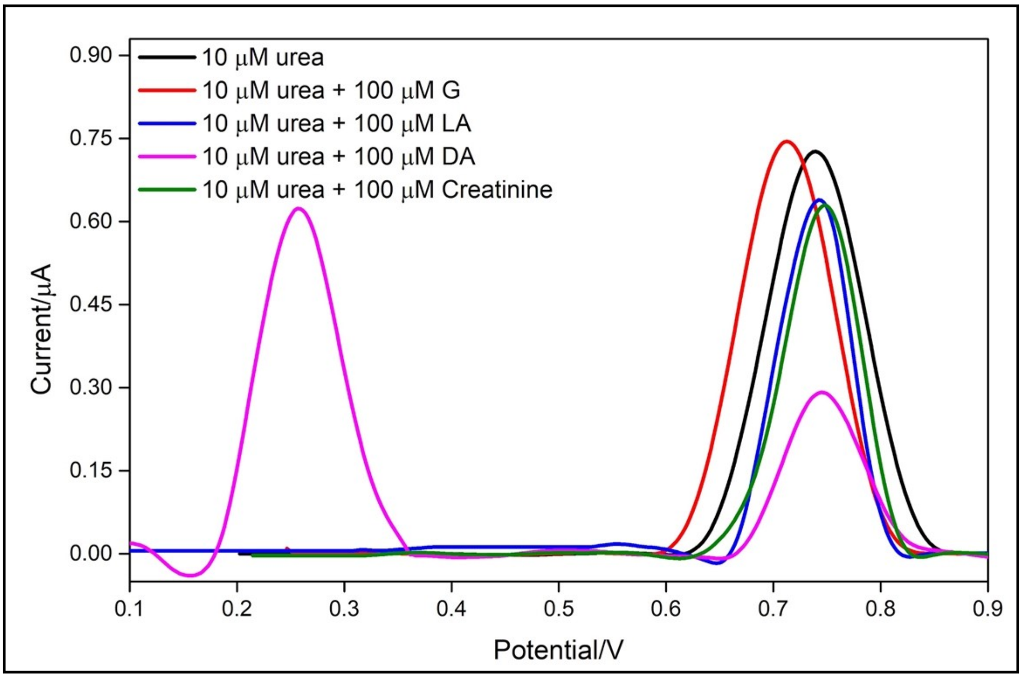

Fig. S3 Linear sweep voltammograms at a scan rate of 50 mV s^{-1} in different media (0.1 M pH 7.40 PBS + KCl) containing 100 μM of G, LA, DA, and creatinine, with 10 μM of urea.

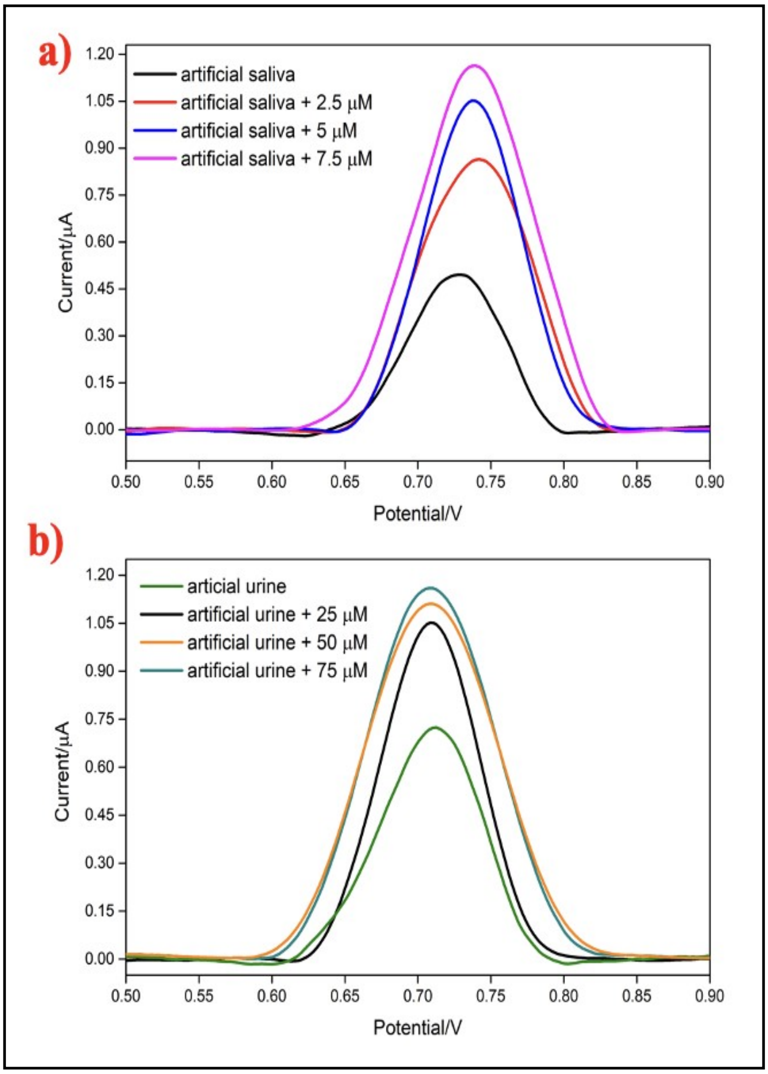

Fig. S4 Linear sweep voltammograms of G/NiO/N-Gr/SPE in a media containing different concentrations of urea (0.1 M PBS+KCl pH 7.40) added to artificial (a) saliva and (b) urine.