

Supporting Information

Nanostructured copper selenide as an ultrasensitive and selective non - enzymatic glucose sensor

Siddesh Umapathi,^a Harish Singh,^a Jahangir Masud^b and Manashi Nath^{a}*

^a Department of Chemistry, Missouri University of Science and Technology, Rolla, USA

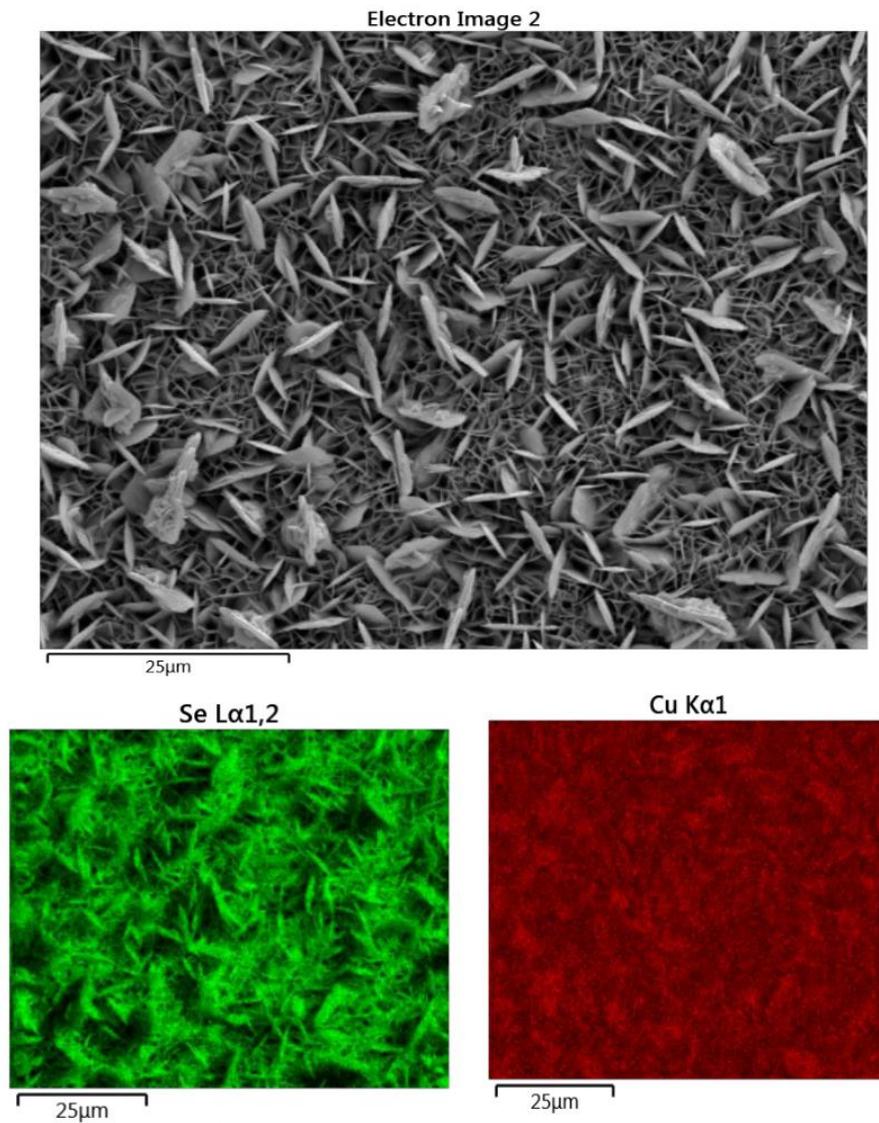
^b Energy and Environmental Research centre, University of North Dakota, Grand Forks, USA

Hydrothermal Synthesis of Copper Selenide

The CuSe was synthesized by hydrothermal method. In a typical procedure, 20 mmol Copper Acetate and Selenium Dioxide (SeO_2) were mixed in 10 ml of DI water. The solution was vigorously mixed on magnetic stirrer for 30 minutes. Then 1 ml of hydrazine hydrate were added to the above solution with constant stirring. After 20 min of stirring, the final solution was transferred to a Teflon-lined stainless steel autoclave of 23 ml capacity. The autoclave was sealed tightly and maintained at 175°C for 24 hr and cooled naturally down to room temperature. Then the final product was centrifuged and washed several times with mixture of ethanol and deionized water. Finally, the obtained product was dried in a vacuum oven at 60°C .

Electrode Preparation

To analyze the activity of hydrothermally synthesized CuSe, a homogeneous catalyst ink was prepared by adding 4 mg of catalyst powder in 300 μL of ethanol mixed with Nafion (0.8 μL 5wt %). This mixture was ultra-sonicated for about 1 hr to generate a homogeneous ink. 40 μL of the ink was drop casted onto carbon cloth (geometric area of 0.08 cm^2), leading to the catalyst loading $\sim 0.53\text{ mg cm}^{-2}$.



Element	Atomic %
Cu	51.2
Se	48.6
O	0.2

Fig. S1. SEM image of CuSe at 1μM magnification, and elemental mapping of CuSe with atomic percentage distribution

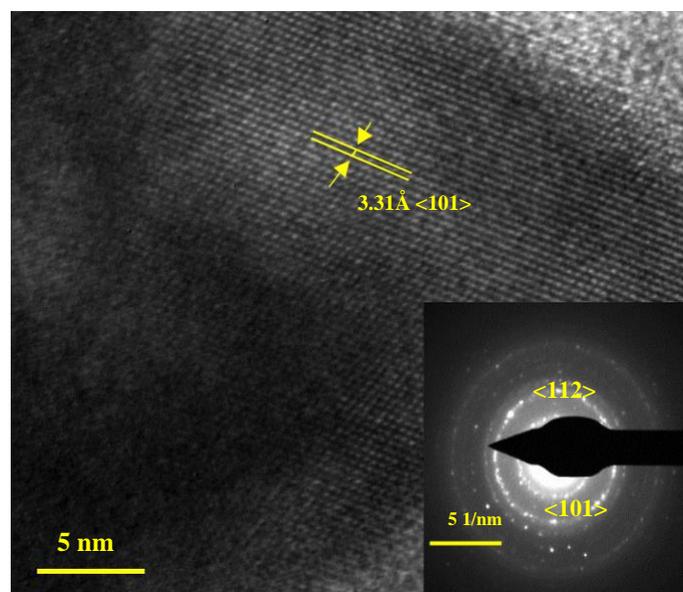


Fig. S2. HR-TEM images of ED- CuSe. Inset shows the SAED pattern confirming formation of the CuSe nanocrystalline phase.

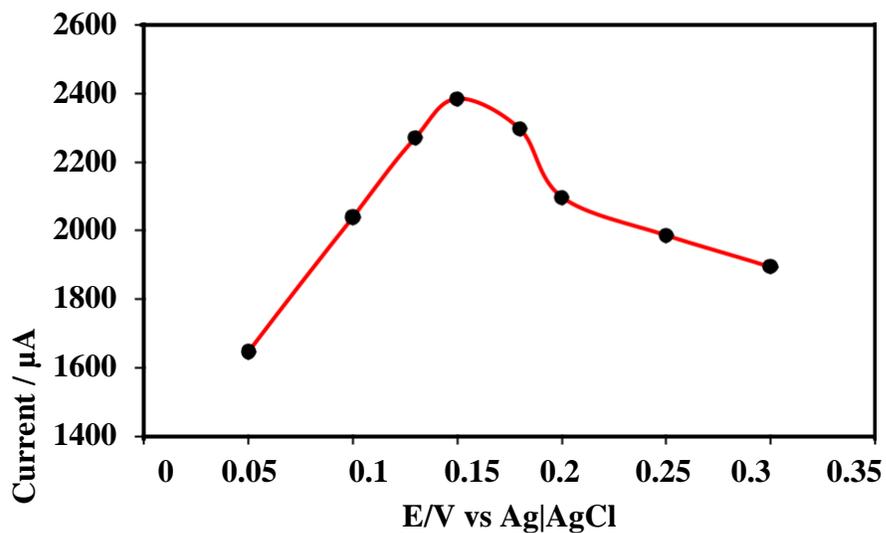


Fig. S3. Current vs voltage curve to determine the ideal working potential for glucose oxidation. The applied potential of +0.15 V vs Ag/AgCl shows the highest current and this potential is used for the rest of amperometric experiments.

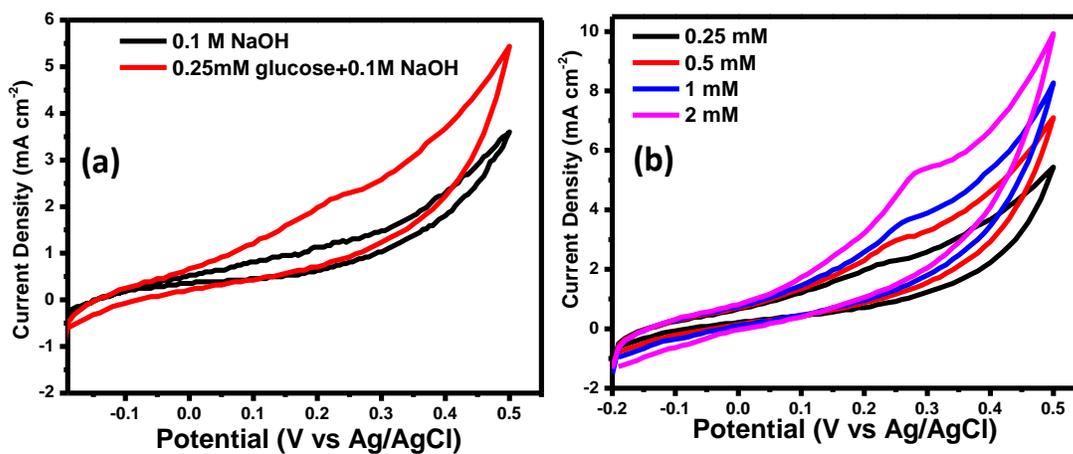


Fig. S4. (a) CV curves of hydrothermally synthesised CuSe with 0.25 mM glucose and no glucose in 0.1 M NaOH solution. (b) CV curves of CuSe with varying concentrations of glucose ranging from 0.25 mM to 2 mM. Fig. 5.

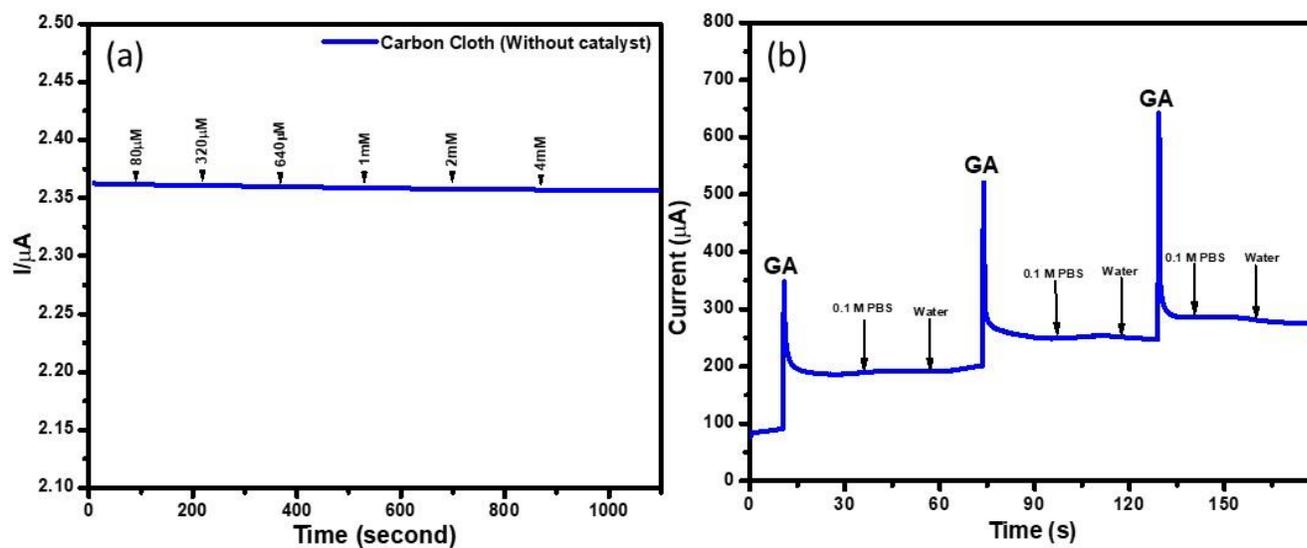


Fig.S5 (a). Amperometric response of carbon cloth electrode (without any catalyst) upon the addition of different concentrations of glucose at 0.15 V. (b) Amperometric response to successive addition of 0.1 Mm of glucose, 0.1M PBS solution and 100 μl of DI water.

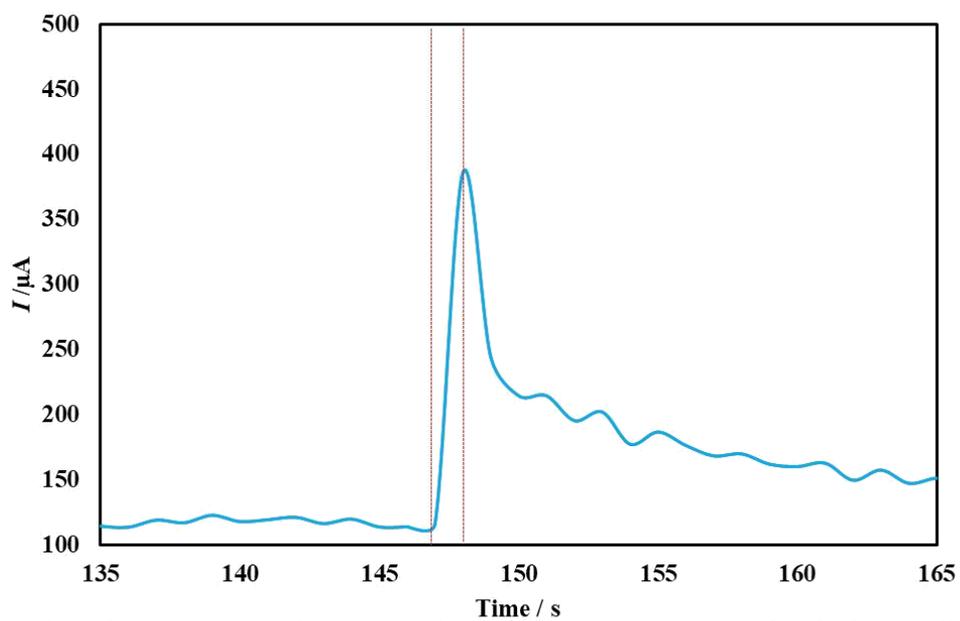


Fig. S6. Plot of the response time to reach the steady-state current for CuSe-modified electrode after injecting glucose solution.

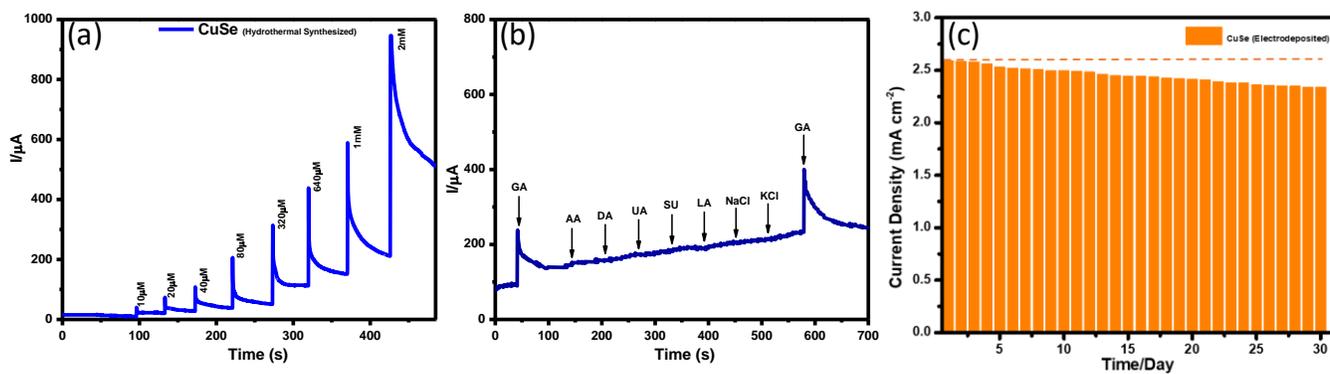


Fig. S7. (a) Chronoamperometric response of the hydrothermally synthesized CuSe electrode to successive additions of glucose into stirred 0.1M NaOH electrolyte. (d) Amperometric response of CuSe, measured in 0.1M NaOH with successive addition of glucose (0.1 mM), AA (0.5 mM), DA (0.5 mM), UA (0.5 mM), Sucrose (0.1 mM), Lactose (0.1 mM), NaCl (0.5 mM), KCl (0.5 mM), and glucose (0.1 mM) at an applied potential of +0.25 V vs Ag|AgCl.(c) Long-term stability check for 30 days of CuSe electrodes by addition of 1mM glucose solution each day for over 30 days

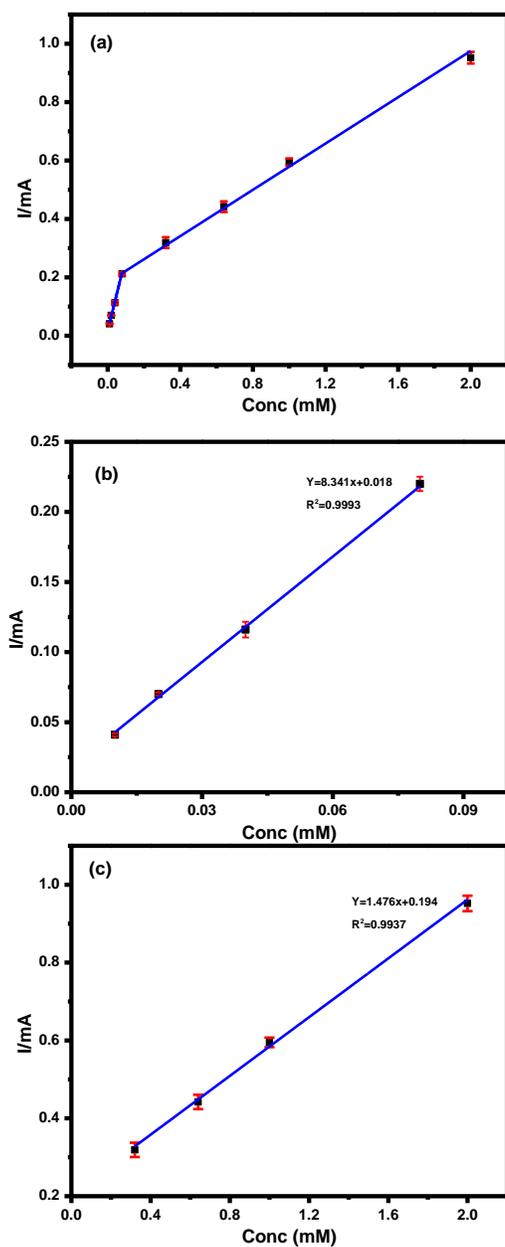


Fig. S8. (a) Peak current versus the concentration of glucose at low and high concentration regions for hydrothermally synthesized CuSe. (b) Linear range from 10 μ M to 80 μ M and (c) linear range from 320 μ M to 2 mM.

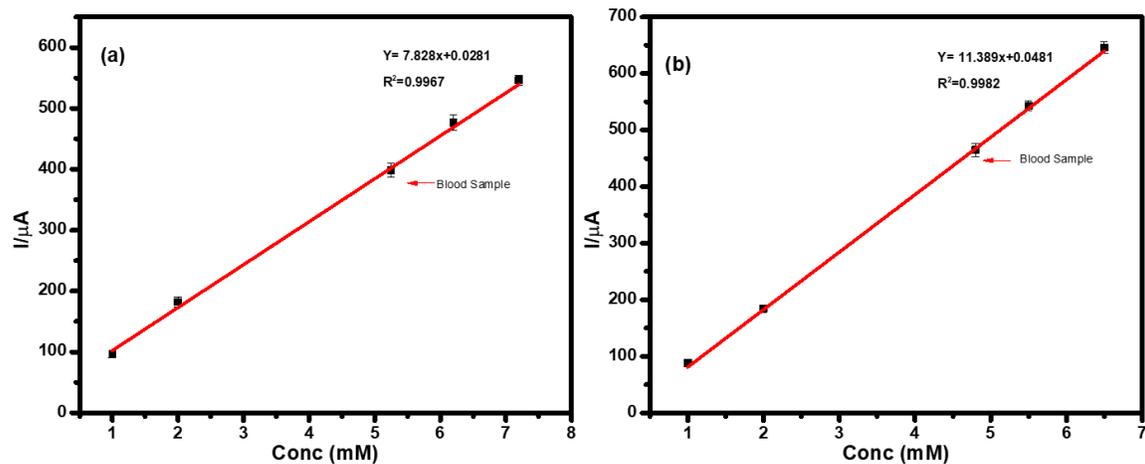


Fig.S9. Estimated the glucose level in two different blood samples with the fitted linear plot of current response vs glucose concentration.

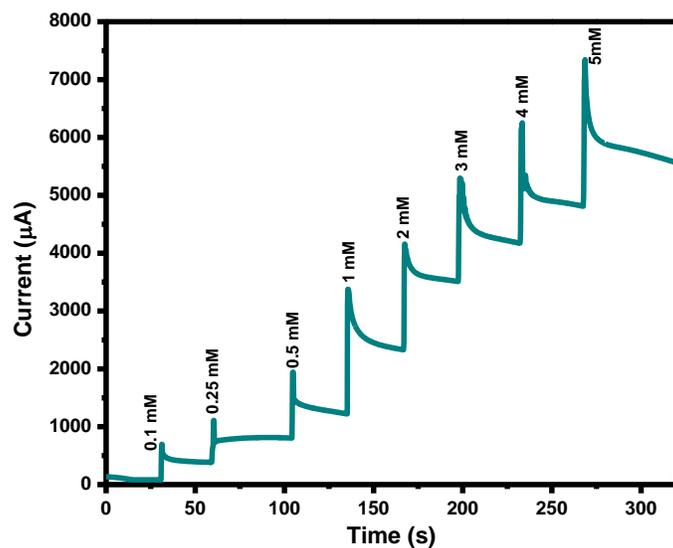


Fig. S10. (a) Chronoamperometric response of the Electrodeposited CuSe electrode to successive additions of glucose (0.1 Mm to 5Mm) into stirred 0.1M NaOH electrolyte.