

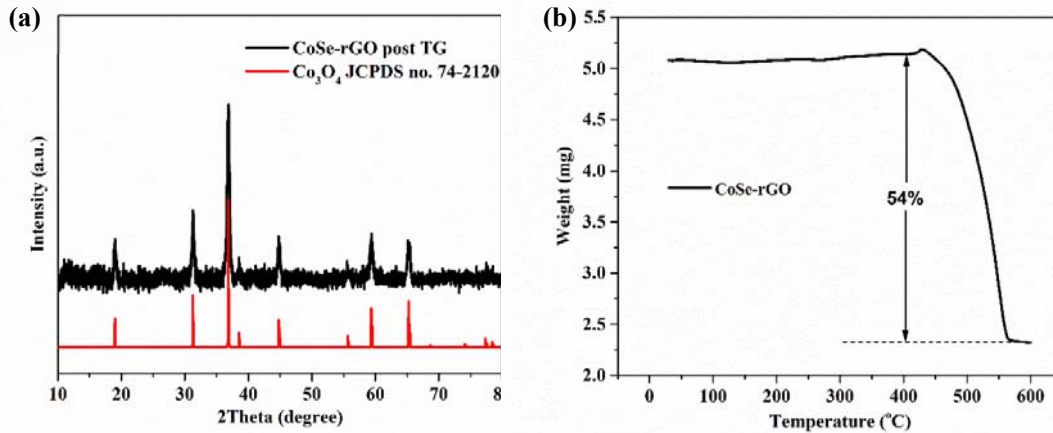
## Supplementary Information

### **Cobalt Selenide Nanoflake Decorated Reduced Graphene Oxide Nanocomposite for Efficient Glucose Electro- Oxidation in Alkaline Medium**

M. C. Dilusha Cooray, Xiaolong Zhang, Ying Zhang, Steven J. Langford, Alan M. Bond, Jie Zhang\*

School of Chemistry, Monash University, Clayton, Victoria 3800, Australia

\* Corresponding author: [jie.zhang@monash.edu](mailto:jie.zhang@monash.edu)



**Figure S1:** (a) Comparison of XRD spectra obtained after TGA experiment with CoSe-rGO and the standard spectrum of Co<sub>3</sub>O<sub>4</sub> (b) TGA data obtained from the CoSe-rGO composite.

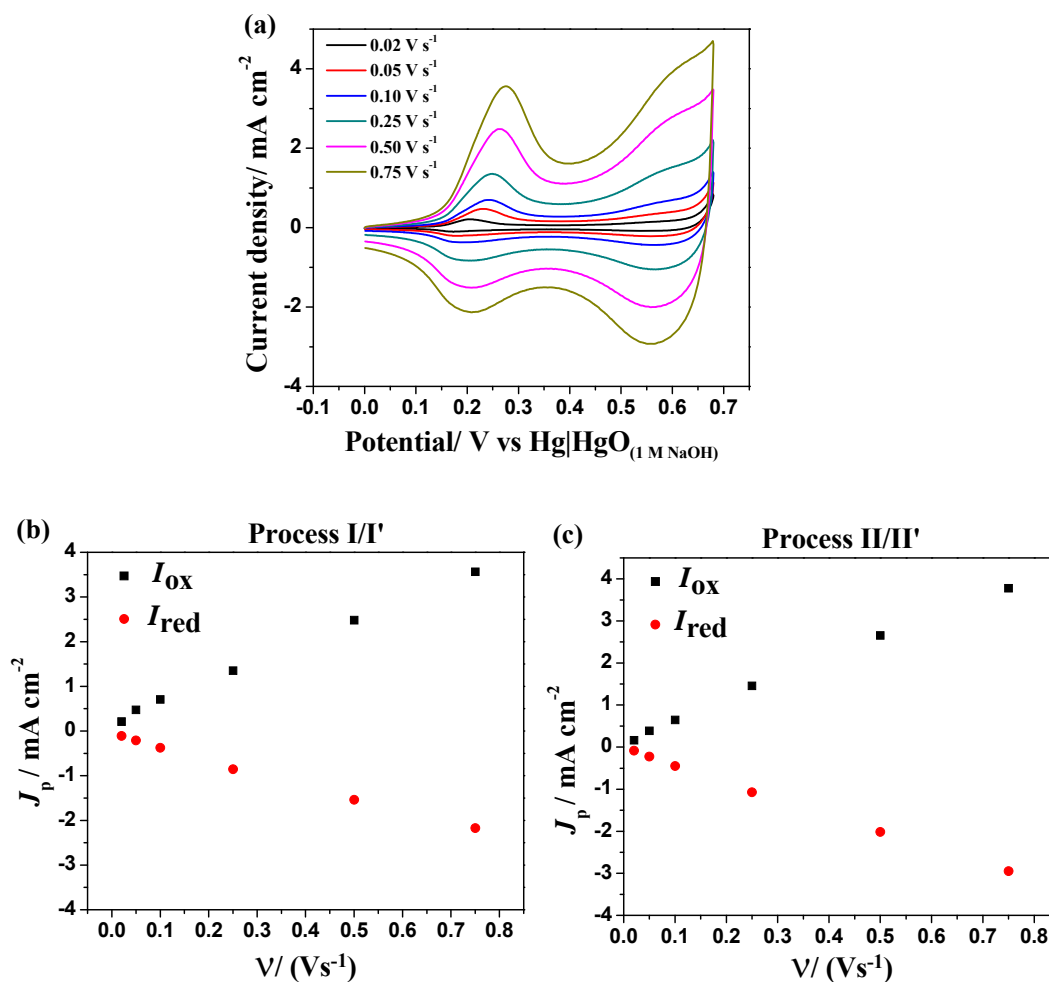
Calculation of percentage composition of CoSe and rGo in the composite:

$$\frac{m_{\text{Co}_3\text{O}_4}}{M_{\text{Co}_3\text{O}_4}} \times 3 \times M_{\text{CoSe}} = m_{\text{CoSe}}$$

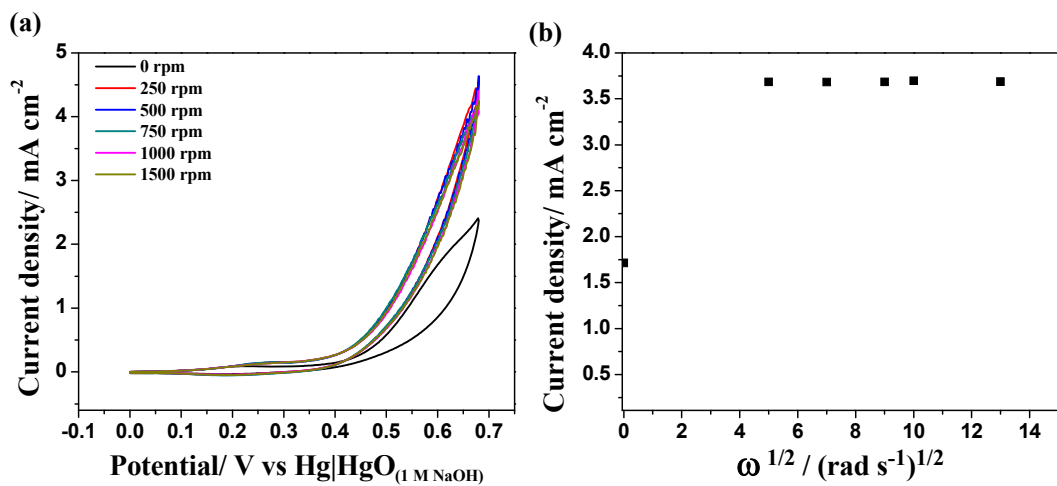
$$\frac{2.32 \times 10^{-3}}{240.8} \times 3 \times 137.89 = 3.99 \text{ mg}$$

$$\% \text{ composition of CoSe in the composite} = \frac{3.99}{5.02} \times 100 = 79 \%$$

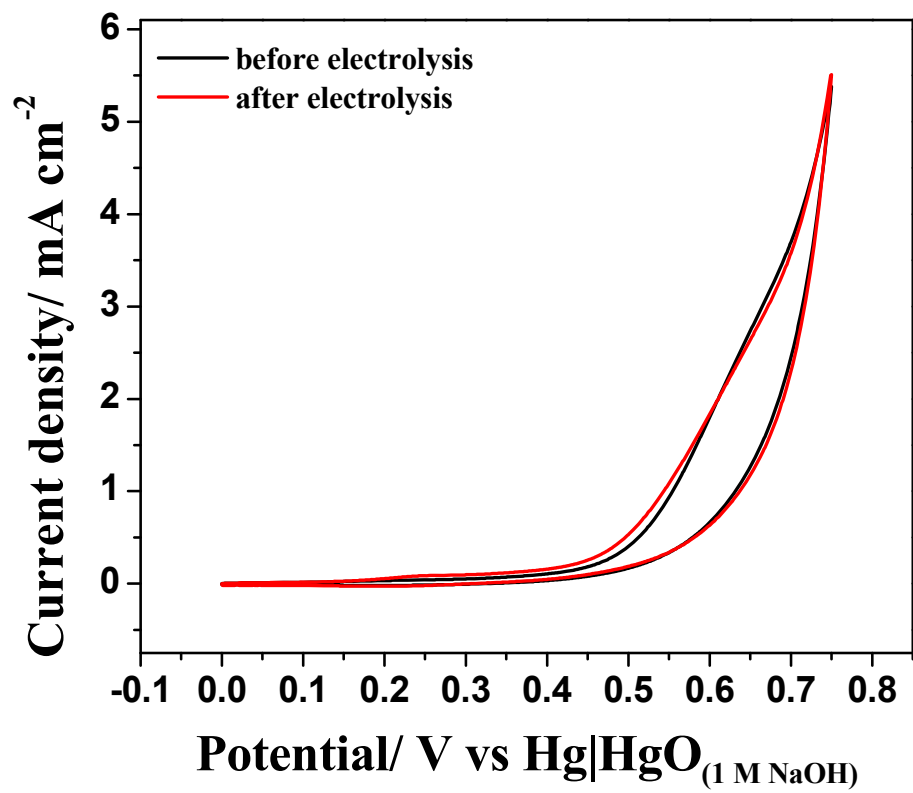
$$\% \text{ composition of rGO in the composite} = 100 - 79 = 21 \%$$



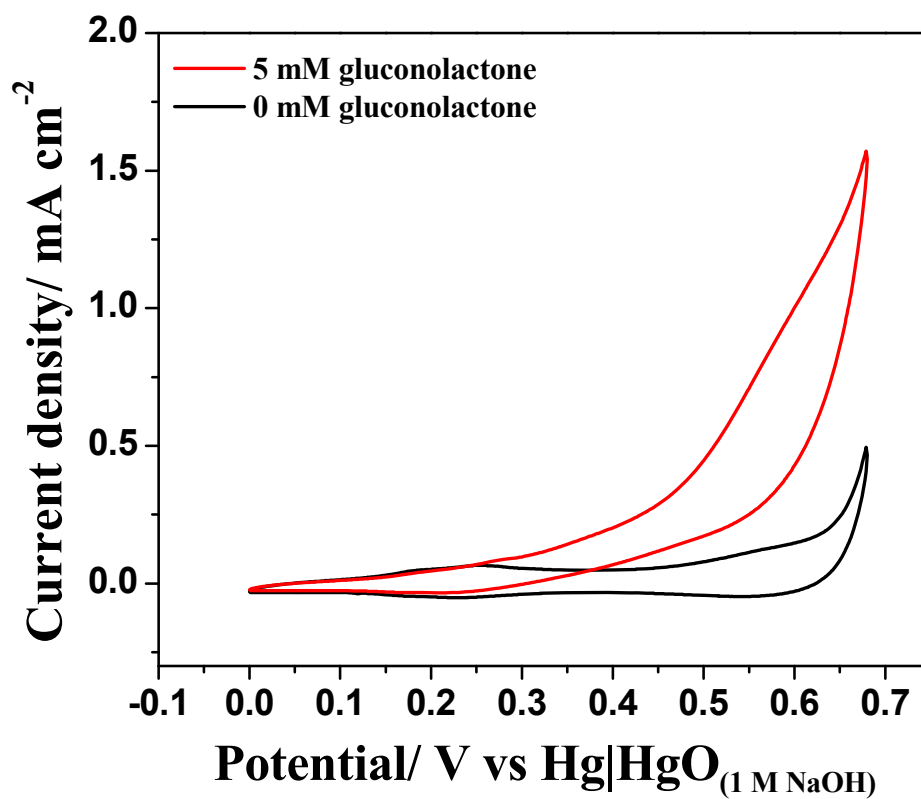
**Figure S2:** (a) Cyclic voltammograms obtained in 0.3 M NaOH with a CoSe-rGO/chit modified GCE as a function of scan rate and plots of the peak current density ( $J_p$ ) versus scan rate for processes I/I' (b) and II/II' (c).



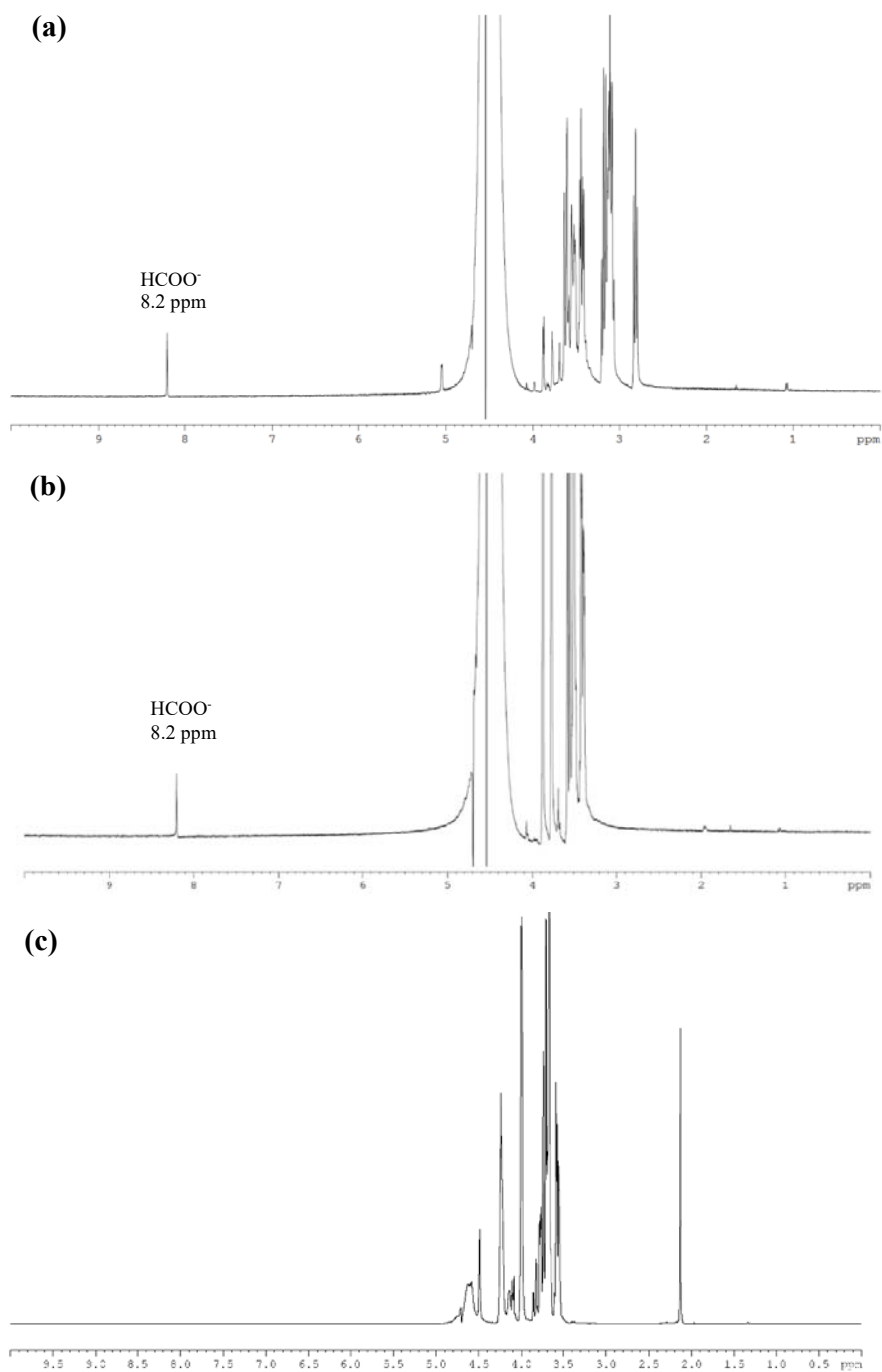
**Figure S3 :** (a) RDE voltammograms obtained at a CoSe-rGO/chit modified GC RDE in a 5.0 mM Glucose (0.3 M NaOH) solution at a scan rate of 0.02 V s<sup>-1</sup> as a function of rotation rate ( $\omega$ ) and (b) the relationship between  $\omega^{1/2}$  and background corrected current density measured at 0.65 V.



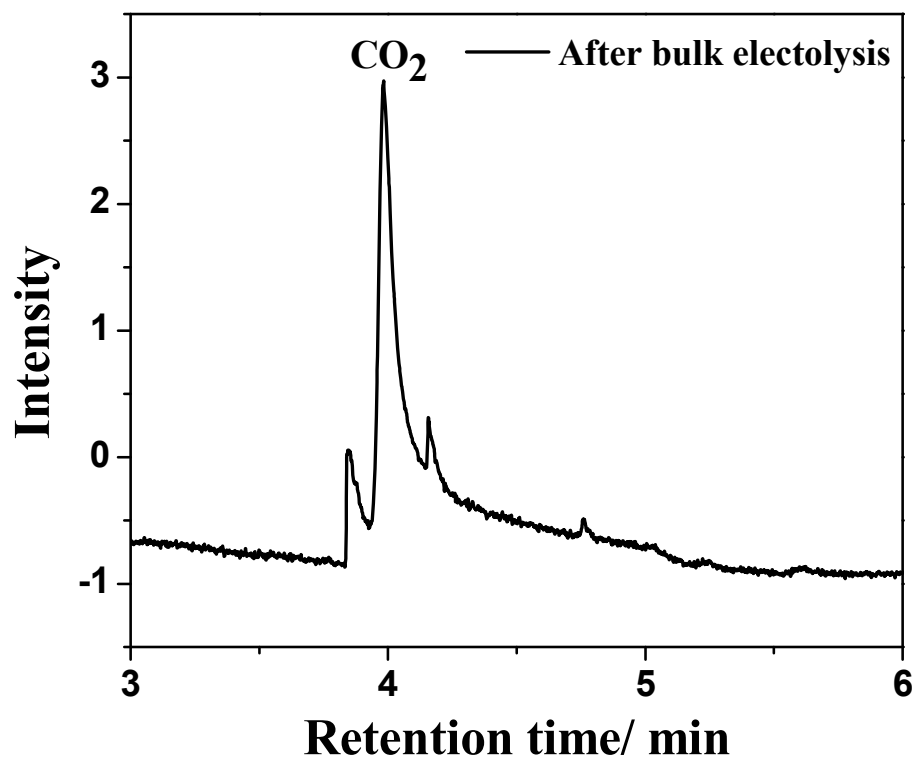
**Figure S4:** Cyclic voltammograms obtained before and after holding the potential of a CoSe-rGO/chit modified GC electrode at 0.7 V vs. Hg|HgO<sub>(1 M NaOH)</sub> for 1 h in a 0.3 M NaOH solution containing 20.0 mM glucose.



**Figure S5:** Cyclic voltammograms obtained over the potential range of 0 to 0.68 V at a scan rate of 0.02 V s<sup>-1</sup> using a CoSe-rGO/chit modified GC electrode in 0.3 M NaOH in the absence (—) and presence (—) of 5.0 mM gluconolactone.

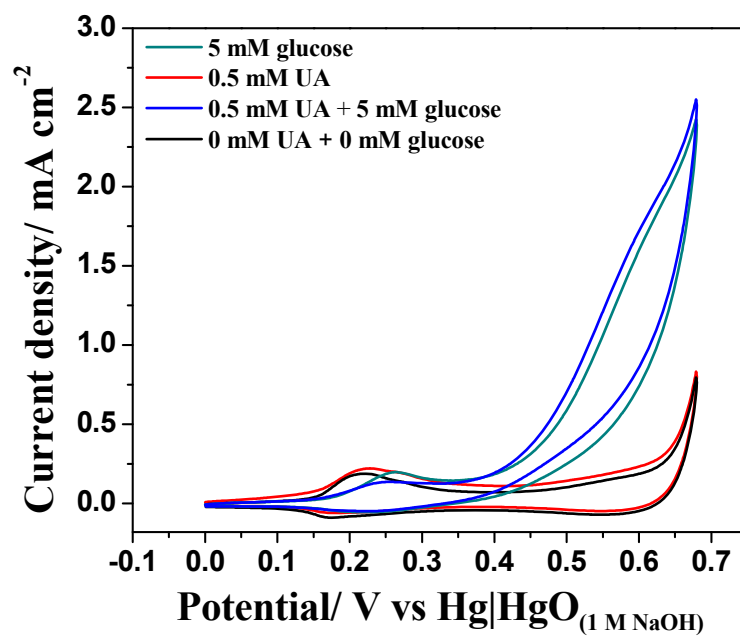


**Figure S6:** <sup>1</sup>H-NMR spectra obtained at 300 K with D<sub>2</sub>O as the solvent after bulk electrolysis of (a) glucose and (b) gluconolactone at 0.7 V vs Hg|HgO(1 M NaOH) using a CoSe-rGO/chit modified GC plate. The <sup>1</sup>H-NMR spectrum obtained under the same conditions before bulk electrolysis of glucose (c) also is shown for comparison.

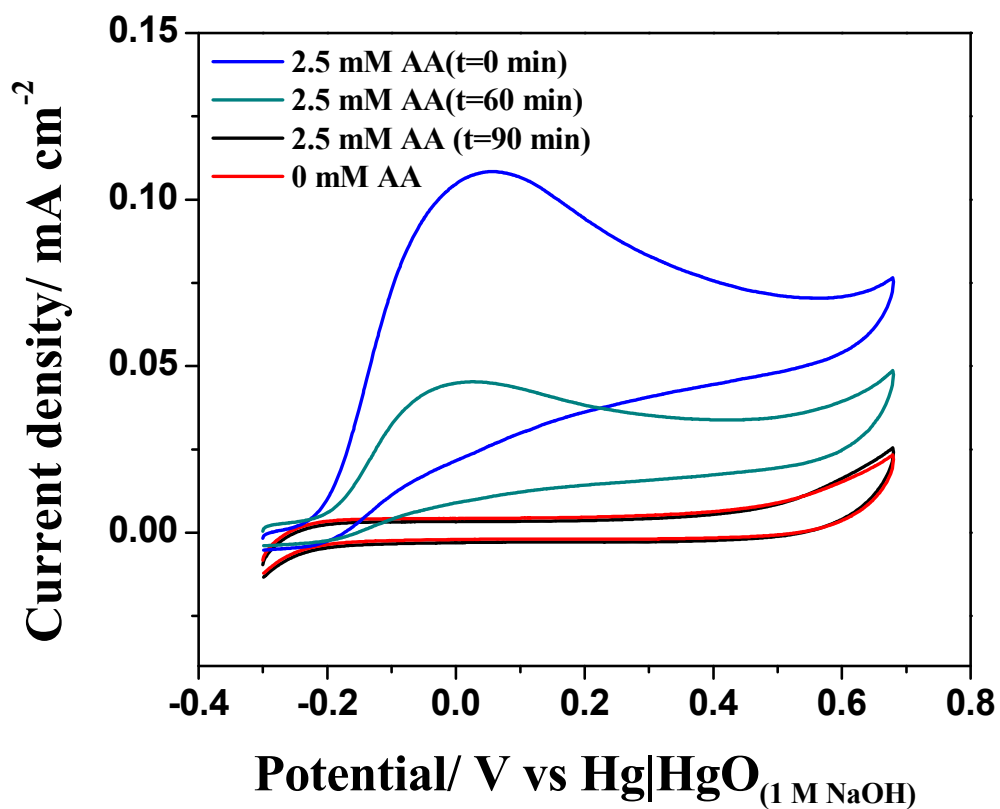


**Figure S7:** Gas chromatogram obtained from a gas sample collected from the head space of an air tight cell after bulk electrolysis at 0.7 V vs Hg|HgO(1 M NaOH) using a CoSe-rGO/chit modified GC plate.

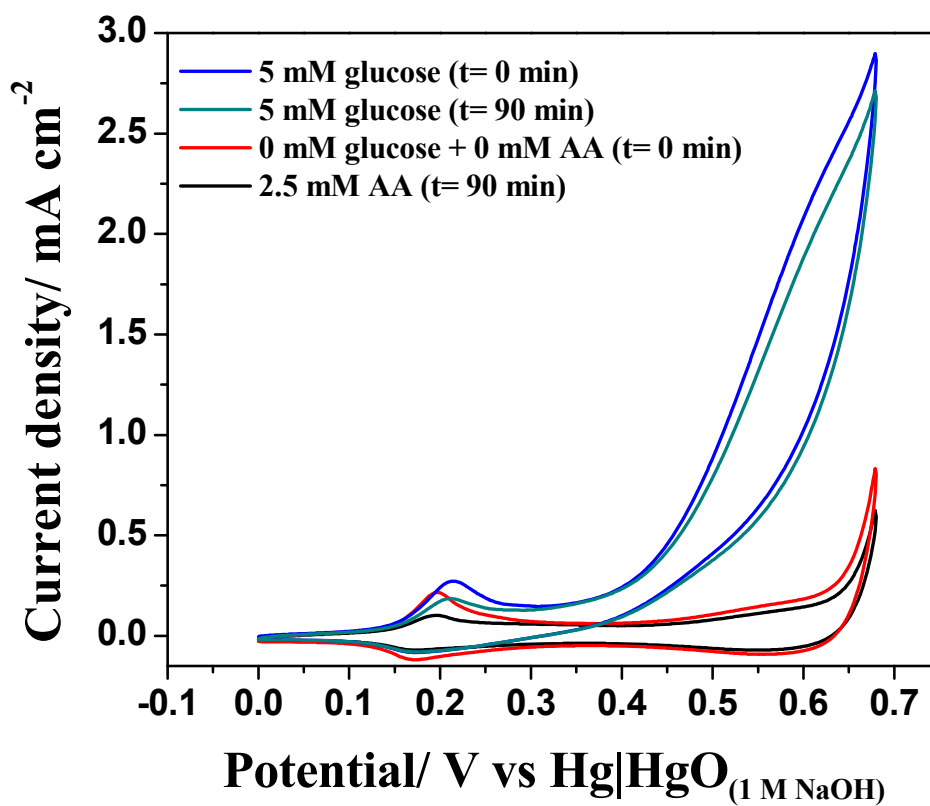




**Figure S8:** Cyclic voltammograms obtained at a scan rate of 0.02 V s<sup>-1</sup> in a 0.3 M NaOH solution containing 5.0 mM glucose with a CoSe-rGO/chit modified GCE in the absence and presence of 0.5 mM UA. The results obtained with a blank solution and with a solution contacting 0.5 mM UA alone also are provided for comparison.



**Figure S9:** Cyclic voltammograms obtained at a scan rate of 0.02 V s<sup>-1</sup> with a bare GCE in a 0.3 M NaOH solution containing 2.5 mM AA after exposure to air for designated amounts of time under stirring conditions. A decrease in the oxidation current was observed due to the oxidation of AA in air. After ~90 min, current dropped to zero indicating all AA was oxidized.



**Figure S10:** Cyclic voltammograms obtained at a scan rate of  $0.02 \text{ V s}^{-1}$  with a CoSe-rGO/chit modified GCE using a freshly prepared  $0.3 \text{ M NaOH}$  solution containing  $5.0 \text{ mM}$  glucose before and after exposure to air for  $90 \text{ min}$  under stirring conditions. The results obtained from a blank solution and from a  $0.3 \text{ M NaOH}$  solution contacting  $2.5 \text{ mM AA}$  after exposure to air for  $90 \text{ min}$  under stirring conditions are also shown for comparison.

**Table S1:** Comparison of performance of electrodes modified with Co based nanocomposites for glucose oxidation

Electrode	Working potential/ V	Electrolyte medium	Sensitivity/ $\mu\text{A cm}^{-2}$ $\text{mM}^{-1}$	Max. current density/ $\mu\text{A cm}^{-2}$	LOD/ $\mu\text{M}$	Linear dynamic range/ $\text{mM}$	Ref
CoO nanorods/FTO	0.5 vs. Ag/AgCl	1 M NaOH	571.8	2500	0.058	0- 3.5	1
Co <sub>3</sub> O <sub>4</sub> NFs-Nafion/GCE	0.59 vs. Ag/AgCl	0.1 M NaOH	36.25	-	0.97	0-2.04	2
CoOOH nanosheets	0.40 vs. Ag/AgCl	0.1 M NaOH	967	790	10.9	0.03- 0.7	3
CoOxNPs/ ERGO/GCE	0.60 vs SCE	0.05 M NaOH	79.3	-	2	0.01– 0.55	4
3D graphene/Co <sub>3</sub> O <sub>4</sub> nanowire composite	0.58 vs. Ag/AgCl	0.1 M NaOH	3390	600	0.025	0- 0.080	5
CoOx·nH <sub>2</sub> O–MWCNTs	0.55 vs. Ag/AgCl	0.2 M NaOH	162.8	1555	2	0-4.5	6
Co <sub>3</sub> O <sub>4</sub> UNS-Ni(OH) <sub>2</sub>	0.35 vs. Ag/AgCl	0.1 M NaOH	1089	2000	1.08	0.005– 0.040	7
CoSe/rGO/chit/GCE	0.65 vs Hg/HgO	0.3 M NaOH	480	5414	2.5	0- 10	This work

Abbreviations: FTO = Fluorine doped Tin Oxide, NFs = nanoflakes, ERGO = electrochemically reduced graphene oxide, UNS = ultra-nanosheets.

1. C.-W. Kung, C.-Y. Lin, Y.-H. Lai, R. Vittal and K.-C. Ho, *Biosens. Bioelectron.*, 2011, **27**, 125-131.
2. Y. Ding, Y. Wang, L. Su, M. Bellagamba, H. Zhang and Y. Lei, *Biosens. Bioelectron.*, 2010, **26**, 542-548.
3. K. K. Lee, P. Y. Loh, C. H. Sow and W. S. Chin, *Electrochem. Commun.*, 2012, **20**, 128-132.
4. S.-J. Li, J.-M. Du, J. Chen, N.-N. Mao, M.-J. Zhang and H. Pang, *J. Solid State Electrochem.*, 2014, **18**, 1049-1056.
5. X.-C. Dong, H. Xu, X.-W. Wang, Y.-X. Huang, M. B. Chan-Park, H. Zhang, L.-H. Wang, W. Huang and P. Chen, *ACS nano*, 2012, **6**, 3206-3213.
6. J. Yang and S. Gunasekaran, *Electrochim. Acta*, 2011, **56**, 5538-5544.
7. M. Mahmoudian, W. Basirun, P. M. Woi, M. Sookhakian, R. Yousefi, H. Ghadimi and Y. Alias, *Mater. Sci. Eng. C*, 2016, **59**, 500-508.