Electronic Supplementary Material (ESI) for Analyst

Supporting Information:

Single On-chip Gold Nanowires For Electrochecmial Biosensing Applications

Karen Dawson, Marine Baudequin and Alan O'Riordan*

Nanotechnology Group, Tyndall National Institute – University College Cork, Lee Maltings, Cork, Ireland. E-mail: alan.oriordan@tyndall.ie

Statistical Analysis on Nanowire Electrode Critical Dimensions:

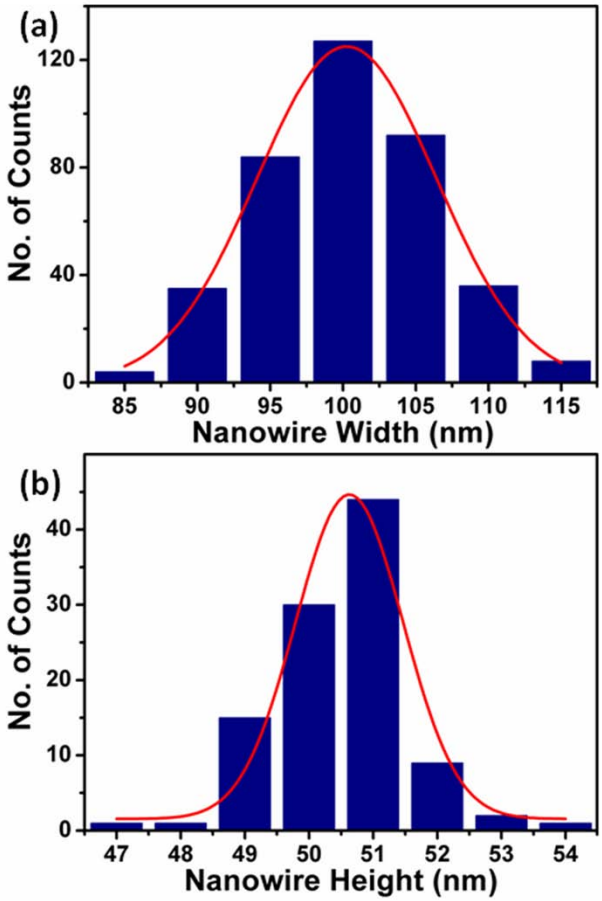

Fig S1: Histograms showing the distribution of widths (a) and heights (b) of nanowires electrodes fabricated by EBL, obtained from SEM and AFM analysis, respectively. Solid red lines are Gaussian fits to the data.

Statistical analysis of nanowire widths from high resolution SEM micrographs, ~ 70,000x magnification, (measured at multiple locations at 18 different nanowires on 5 separate chips) showed very reproducible nanowire widths of 100 ± 6 nm, see Fig S1(a). Statistical analysis of AFM nanowire profile data acquired from a number of nanowire measurements (captured from multiple locations on 5 different nanowires on 3 separate chips) showed an average height of 50.6 ± 0.8 nm, see Fig S1(b).

Electrochemical Cell Set-up:

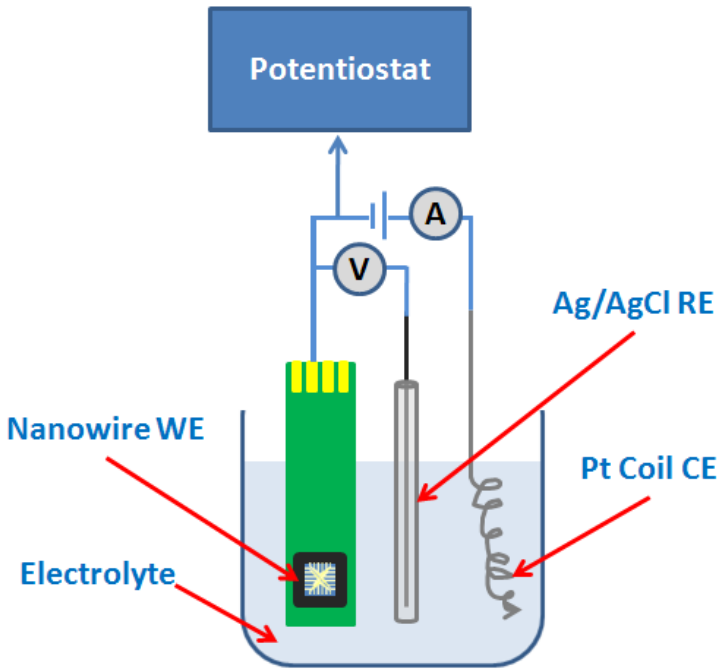

Fig S2: Schematic representation of three-electrode electrochemical cell setup employed. PCB mounted nanowire electrodes served as working electrodes (WE), coupled with a platinum coil counter electrode (CE) and Ag/AgCl KCl Sat., reference electrode (RE).

Chips bearing nanowire electrodes were mounted onto purpose designed printed circuit boards (PCBs). The on chip interconnection tracks to the nanowires were wedge wire bonded to the PCBs and finally a layer of epoxy was employed to insulate the bond pads, wire-bonds and on-board pin-outs. In the electrochemical cell, the PCB mounted nanowire electrodes were immersed in electrolyte, covering the active region. A direct electrical connection was then made to the potentiostat by the millimetre scale pin-outs at the other end of the PCB, consistent with a conventional electrode.

Optimisation of Mediator and Supporting Electrolyte:

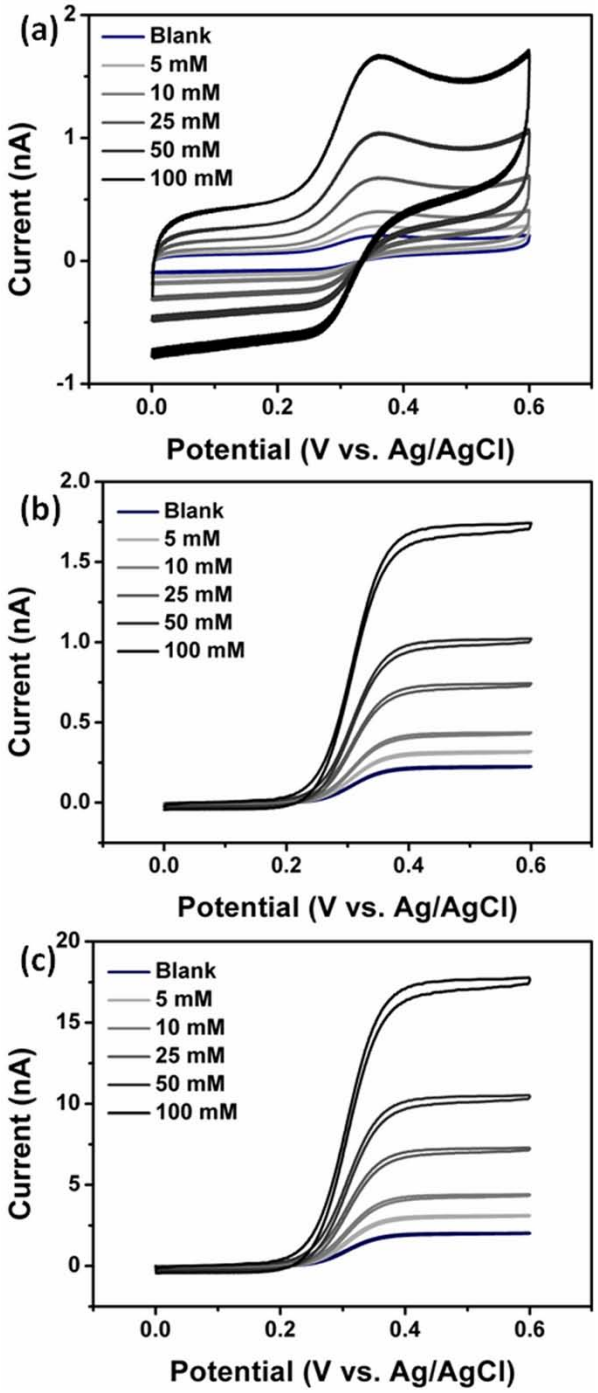

Fig S3: Optimisation of Electrolyte conditions: cyclic voltammograms of increasing concentrations of glucose at a single nanowire electrode, at 50 mV s^{-1} in the presence of (a) 1 mM FcCOOH, 1 mg ml^{-1} GOx in 100 mM PBS, pH 7.0, (b) 1 mM FcCOOH, 1 mg ml^{-1} GOx in 10 mM PBS, pH 7.4, and (c) 10 mM FcCOOH, 1 mg ml^{-1} GOx in 10 mM PBS, pH 7.4.

The concentration of the mediating species and buffer electrolyte was optimised to maximise signal current in the presence of glucose. Preliminary experiments were conducted in 1 mM FcCOOH in 100 mM PBS, pH 7.0, which is consistent with previous work undertaken using soluble GOx based glucose detection (Jimenez and Katz, et al, *J. of Phys Chem C*, 2008). A linear increase in signal was observed for a concentration range of 1 – 100 mM. However, at this buffer concentration the background (capacitive) current was significant, resulting in broad voltammograms; see Figure S3 (a) swamping signals at

low concentrations and thus preventing low limits of detection. To address this problem, we reduced the buffer concentration to 10 mM PBS, pH 7.4 while keeping the mediator concentration constant at 1 mM FcCOOH. Experiments were again undertaken in the glucose concentration range of 1 mM to 100 mM.

Steady-state cyclic voltammograms were obtained exhibiting significantly reduced background (capacitive) current, see Figure S3 (b). Although the current response signal observed at the lower end of the concentration range was steady-state the magnitude of the detection signal was very low (~0.200 pA @ 1 mM) and approached the lower limit of the instrument. To permit detection of lower concentrations of glucose, we increased the concentration of the mediator species to 10 mM in 10 mM PBS resulted in a 10 fold increase in measured current, see Figure S3 (c). These optimal concentrations of both mediator and electrolyte were used for subsequent glucose detection.