

## Non-Enzymatic Glucose Oxidation at Electrocatalytic Metal Oxide Films

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Glucose-electrooxidation is an important biomedical and commercial process with demonstrated applications in a wide variety of fields [1-4]. Sensitive and selective glucose sensors are not only relevant for use in blood sugar monitoring, but also in the food industry, bio-processing and in the development of renewable, sustainable fuel cells. In recent years non-enzymatic electrodes, involving direct oxidation of glucose at the electrode surface, have shown promise as a potential fourth generation of electrodes for analytical glucose oxidation [3]. This approach is particularly attractive as it dispenses with the need to use fragile and relatively temperamental enzymes thereby increasing both the simplicity and stability of the electrode device [3,4]. In addition, non-enzymatic electrodes typically possess superior electrocatalytic properties to those of their enzymatic counterparts, making them highly sensitive glucose sensors and efficient electrocatalysts for the fuel cell industry [5,6].

In the present work we focus on the electrooxidation of glucose at nickel oxide films in alkaline solution. The oxide layers have been electrodeposited onto a gold substrate using a repetitive potential cycling technique (Fig. 1a). The resulting oxide film is found to oxidise glucose at low potentials where Ni(III) is generated (Fig. 1b). We clearly demonstrate that the Ni(III) directly oxidises glucose while being itself reduced to Ni(II). The active Ni(III) form is then regenerated by continued application of the oxidising potential to the electrode surface. In this way the immobilised nickel oxide acts as both catalyst and mediator. Here we study the electrocatalytic properties of the nickel oxide layer towards glucose oxidation using a combination of rotating disk electrode voltammetry and electrochemical impedance spectroscopy. The kinetics of this process are examined from the perspective mass-transport corrected Tafel analysis and Koutecky-Levich plots. Furthermore, we show using amperometric techniques that this simple

modified electrode exhibits excellent sensitivity for the oxidation of glucose, displaying current increases of ca.  $3.7 \text{ mA mM}^{-1} \text{ cm}^{-2}$  with a limit of detection of the order of  $2.0 \text{ }\mu\text{M}$  glucose.

**Acknowledgements**

This publication has emanated in part from research conducted with the financial support of Science Foundation Ireland (SFI) under Grant Number SFI/10/IN.1/I2969.

**References**

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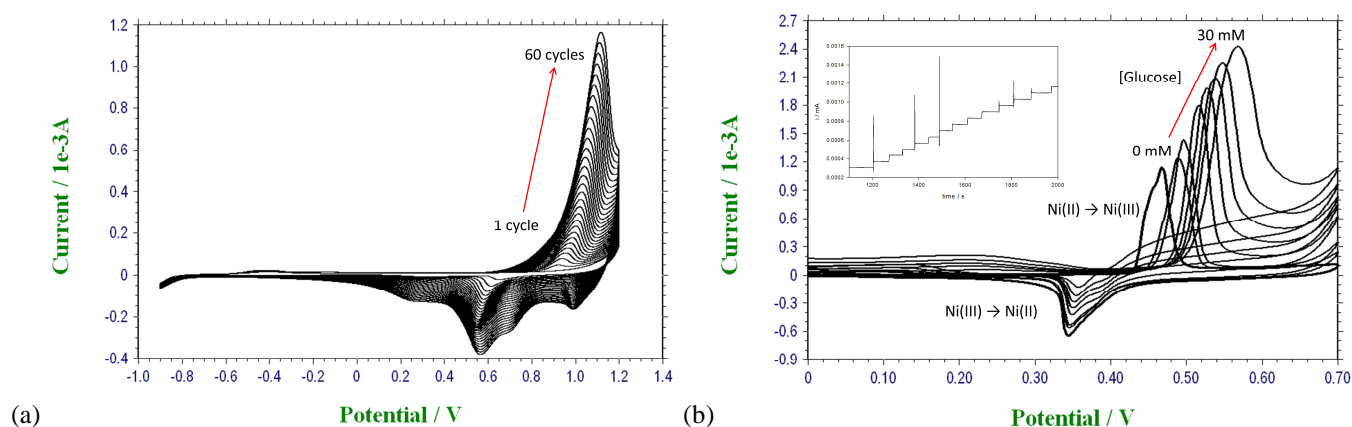


Figure 1. (a) Cyclic voltammograms recorded during the deposition of the nickel oxide layer. (b) Cyclic voltammograms recorded for a nickel oxide modified gold electrode in aqueous alkaline solution containing various concentrations of glucose. The inset shows the amperometric response of the modified electrode to additions of glucose at a constant potential of 0.65 V vs. Hg/HgO and a rotation speed of 2000 rpm.