$Ni(OH)_2/Co(OH)_2$-Based Non-Enzymatic Glucose Sensors

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Reliable and fast methods for monitoring glucose have been of great interests for clinical analysis, food industry, biotechnology, and so forth. Recently, several kinds of metal oxides, e.g., CuO, MnO_2 , NiO_x , and CoO_x , have been extensively explored as the non-enzymatic sensing materials. To date, how to simply fabricate an effective glucose sensor with a less positive detecting potential becomes a new challenge in the electroanalytical technology. This work demonstrates the fabrication of an enzymeless amperometric sensor based on $Ni(OH)_2/Co(OH)_2$ composites directly grown on screen-printed carbon electrodes (SPCEs). The purpose of this work tries to develop the enzymeless glucose sensor with a broad calibration curve and a high signal-to-noise (S/N) ratio.

From the XPS spectra of three samples prepared here (see Fig.1), the deposited materials are indicated to be hydroxides consisting of $Ni(OH)_2$, $Co(OH)_2$ and $Ni(OH)_2/Co(OH)_2$, respectively.Figure 2 reveals that $Ni(OH)_2/Co(OH)_2$ composite gives more obvious peaks of glucose oxidation than $Co(OH)_2$ and reduces the detecting potential (at ca. 0.45V) in comparison with $Ni(OH)_2$. Figure 3 shows the current response of the non-enzymatic glucose sensor at 0.425 V to the successive addition of glucose. From an examination of inset in Fig. 3, the corresponding calibration curve is linear up to 3.7 mM with a sensitivity of 122.45 μA mM^{-1} cm^{-2} and a correlation coefficient of 0.989. The interference responses obtained on $Ni(OH)_2/Co(OH)_2$ to 25 μM AA, UA, and Dopamine respectively are 10.76%, 14.29% and 1.41% of that of 0.2 mM glucose (see Table 1). Therefore, the $Ni(OH)_2/Co(OH)_2$ composites have been demonstrated to obtain lower detecting potential, more obvious signal, and a wider calibration curve range for an enzymeless glucose sensor in this work.

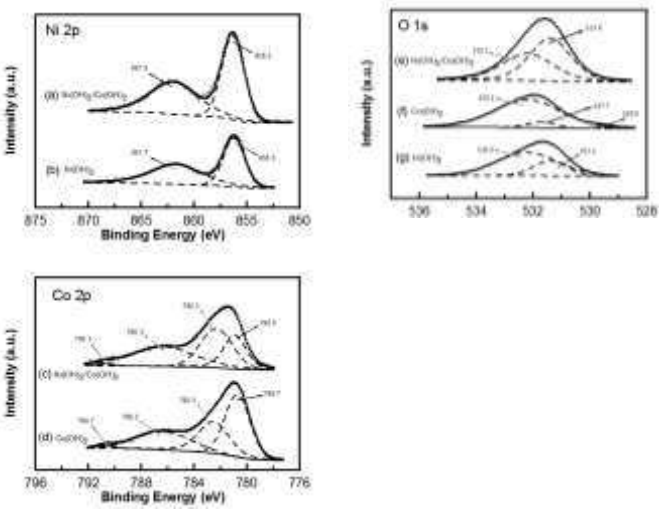

Fig. 1 XPS core-level spectra of Ni 2p, Co 2p and O 1s regions of (a, c, e) $Ni(OH)_2/Co(OH)_2$ composites, (b, g) $Ni(OH)_2$, and (c, f) $Co(OH)_2$

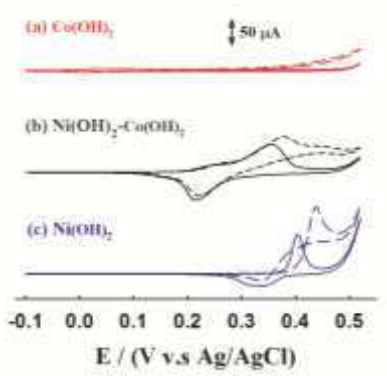

Fig.2 CVs responses of (a) $Co(OH)_2$, (b) $Ni(OH)_2/Co(OH)_2$, and (c) $Ni(OH)_2$ without (solid line) and with 1 mM glucose (dash line).

Table 1 The interference responses on a $Ni(OH)_2/Co(OH)_2$ electrode with the addition of 25 μM ascorbic acid (AA), uric acid (UA), dopamine and 0.2 mM glucose in 0.5 M NaOH.

Chemistry	Current response (mA)
25 mM ascorbic acid(AA)	0.61
25 mM uric acid (UA)	0.81
25 mM dopamine	0.08
0.2mM glucose	5.67

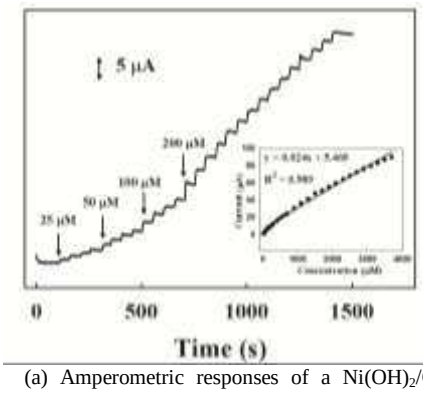

Fig. 3 (a) Amperometric responses of a $Ni(OH)_2/Co(OH)_2$ electrode with the continuous addition of glucose in 0.5 M NaOH. Inset shows the calibration curve of adding glucose.

1. Both the authors contributed equally.