Electronic Supporting Information (ESI)

Electrochemical reduction of hydrogen peroxide by nanostructured hematite modified electrodes

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Table S1 Summary of values of $I_{pc}$ and $E_{pc}$ of the FTO and nanostructured $\alpha$-Fe$_2$O$_3$ electrodes.

<table>
<thead>
<tr>
<th>Sample</th>
<th>FTO</th>
<th>$\alpha$-Fe$<em>2$O$</em>{3NR}$</th>
<th>$\alpha$-Fe$<em>2$O$</em>{3NS}$</th>
<th>$\alpha$-Fe$<em>2$O$</em>{3NP}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J_{pc}$ $^a$</td>
<td>-0.933</td>
<td>-0.900</td>
<td>-1.027</td>
<td>-1.102</td>
</tr>
<tr>
<td>(mA cm$^{-2}$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$E_{pc}$ $^b$</td>
<td>-0.558</td>
<td>-0.424</td>
<td>-0.404</td>
<td>-0.374</td>
</tr>
<tr>
<td>(V vs. Ag/AgCl)</td>
<td></td>
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</tr>
</tbody>
</table>

$^a$: cathodic peak current density; $^b$: cathodic peak potential. All parameters are determined in Na$_2$SO$_4$ solution (pH 7) containing 4.95 mM H$_2$O$_2$. 

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Figure S1 XRD patterns of (a) \( \alpha \text{-Fe}_2\text{O}_{3\text{NR}} \), (b) \( \alpha \text{-Fe}_2\text{O}_{3\text{NS}} \), and (c) \( \alpha \text{-Fe}_2\text{O}_{3\text{NP}} \).
Figure S2 CVs of (a) α-Fe$_2$O$_{3NR}$, (b) α-Fe$_2$O$_{3NS}$, and (c) α-Fe$_2$O$_{3NP}$ modified electrodes recorded at various scan rates (v), including 2.5, 5, 10, and 20 mV s$^{-1}$, in 0.1 M Na$_2$SO$_4$ electrolyte (pH 7). The plots of $\Delta$current density vs. v, where the $\Delta$current density is the sum of the anodic current and cathodic current measured at 0.3 V vs. Ag/AgCl from (a), (b), and (c), are shown in (d). The capacitances of the nanostructured α-Fe$_2$O$_3$ were then estimated from the slope of the curve of charging current density vs. v (c), where the slope is equal to 2C$_{dl}$. However, since the area-averaged capacitance of α-Fe$_2$O$_3$ is unknown, the relative effective surface area, i.e., the normalized slopes of curves in (d) with respective to curve (i), is calculated instead of actual effective surface area. As revealed in (d), the relative surface area of α-Fe$_2$O$_{3NR}$, α-Fe$_2$O$_{3NS}$, and α-Fe$_2$O$_{3NP}$ is found as 1.00: 1.58: 1.74.
Figure S3 Plots of peak current density ($J_p$) vs. scan rate for the pretreated (a) $\alpha$-Fe$_2$O$_{3NR}$, (b) $\alpha$-Fe$_2$O$_{3NS}$, and (c) $\alpha$-Fe$_2$O$_{3NP}$ in 0.1 M PBS (pH 7) under N$_2$ atmosphere.
**Figure S4** I-t transient of the $\alpha$-Fe$_2$O$_3$$|$FePO$_4$ electrode recorded at an applied potential of -0.3 V vs. Ag/AgCl on successive additions of the H$_2$O$_2$ solution of different concentrations into the deaerated 0.1 M PBS (pH 6). Inset: calibration curve for current density versus concentration of H$_2$O$_2$. 
Figure S5 Cyclic voltammetry, recorded at a scan rate of 20 mV s\(^{-1}\), of (a) FTO, (b) \(\alpha\)-Fe\(_2\)O\(_3\)NR, (c) \(\alpha\)-Fe\(_2\)O\(_3\)NS, and (d) \(\alpha\)-Fe\(_2\)O\(_3\)NP in 0.1 M Na\(_2\)SO\(_4\) solution (pH 7) containing H\(_2\)O\(_2\) of various concentrations (0, 1.66, 3.31, and 4.95 mM).
Figure S6 CVs, recorded at a scan rate of 20 mV s$^{-1}$, of (a) \( \alpha\)-Fe$_2$O$_3$NR, (b) \( \alpha\)-Fe$_2$O$_3$NS, and (c) \( \alpha\)-Fe$_2$O$_3$NP in 0.1 M Na$_2$SO$_4$ electrolyte containing 1.66 mM H$_2$O$_2$ at various pHs ranging from 4 to 7.

Figure S7 Sensitivities of \( \alpha\)-Fe$_2$O$_3$NR\|FePO$_4$, \( \alpha\)-Fe$_2$O$_3$NS\|FePO$_4$, and \( \alpha\)-Fe$_2$O$_3$NP\|FePO$_4$ towards the electrochemical reduction of H$_2$O$_2$ in 0.1 M PBS (pH 6) under N$_2$ and air atmospheres. The sensitivity was obtained from Figure 7.