Supplementary Information

Au-Pd bimetallic nanoparticles anchored on $\alpha$-Fe$_2$O$_3$ nonenzymatic hybrid nanoelectrocatalyst for simultaneous electrochemical detection of dopamine and uric acid in the presence of ascorbic acid

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Figure S1. UV visible spectra of (A) $\alpha$–Fe$_2$O$_3$ (B) $\alpha$–Fe$_2$O$_3$ /Au-Pd hybrid nanostructure

Figure S2. 1mM of (a) Ascorbic acid, (b) Dopamine (c) Uric acid in PBS (pH 7) for the $\alpha$–Fe$_2$O$_3$ /Au-Pd hybrid modified electrode
Figure S3. CVs obtained for (1mM) PBS at a 50 mV s\(^{-1}\) with addition 25 µM of Methylene blue at a (A) bare (B) \(\alpha\)-Fe\(_2\)O\(_3\) (C) Au-Pd (D) \(\alpha\)-Fe\(_2\)O\(_3\).Au-Pd hybrid at a potential between -0.3 and 0.2 V (pH 7).
Figure S4. (A) CV studies recorded at different scan rate from (10 – 100 mVs\(^{-1}\)) (a) Bare GC (b) \(\alpha-\text{Fe}_2\text{O}_3\) (c) Au/Pd (d) \(\alpha-\text{Fe}_2\text{O}_3\)/Au-Pd hybrid for dopamine. Fig (B) differ scan rate for (10 -100 mV s\(^{-1}\)) (a) Bare GC (b) \(\alpha-\text{Fe}_2\text{O}_3\) (c) Au/Pd (d) \(\alpha-\text{Fe}_2\text{O}_3\)/Au-Pd hybrid for uric acid.

Figure S5. Amperometry (Time Vs Current) for modified \(\alpha-\text{Fe}_2\text{O}_3\)/Au-Pd hybrid GC for dopamine & uric acid of 50 µM concentration while other interfering analytes of 5 mM concentration.
Figure S6. shows the response of $\alpha$–Fe$_2$O$_3$/Au-Pd hybrid GC at different concentration of urine sample 1 (a) 1 µM, (b) 3 µM, (c) 5 µM, (d) 6 µM, (e) 10 µM, (f) 20 µM, (g) 40 µM, (h) 60 µM, (i) 70 µM (j) 90 µM in 0.1 M PBS containing pH 7.0.

Figure S7. shows the response of $\alpha$–Fe$_2$O$_3$/Au-Pd hybrid GC at different concentration of urine sample 2 (a) 1 µM, (b) 2 µM, (c) 5 µM, (d) 20 µM, (e) 70 µM, (f) 80 µM, (g) 90 µM, (h) 200 µM, (i) 300 µM, (j) 500 µM in 0.1 M PBS containing pH 7.0.
Figure S8. shows the response of $\alpha$–Fe$_2$O$_3$/Au-Pd hybrid GC at different concentration of fresh human blood serum (a) 300 nM (b) 1µM (c) 4 µM (d) 5 µM (e) 10 µM (f) 25 µM (g) 50 µM containing 0.1M of PBS (pH 7.0).

Figure S9. shows the response of $\alpha$–Fe$_2$O$_3$/Au-Pd hybrid GC at different concentration of dopamine hydrochloride injection (a) 450 nM, (b) 4 µM, (c) 6µM, (d)10 µM, (e) 15 µM, (f) 25 µM, (g) 50 µM, (h) 60 µM containing 0.1M of PBS (pH 7.0)
Figure S 10. shows different ratio for Au/Pd bimetal (a) 1:1 (b) 1:0.5 (c) 0.5:1 (d) 1:0.25 (e) 0.25:1 ratio containing 600 µM of dopamine & uric acid in 0.1 M of PBS (pH 7.0)

Table S1 - Voltammetric DA, UA in presence of AA recovery tests performed in Human Urine, Serum and Dopamine hydrochloride injection with α–Fe$_2$O$_3$ / Au@Pd, pH = 7.0

<table>
<thead>
<tr>
<th>Sample</th>
<th>Added [DA, UA] µM</th>
<th>Obtained [DA, UA] µM</th>
<th>Recovery (%) [DA, UA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine 1</td>
<td>—, 5.00</td>
<td>—, 5.06</td>
<td>—, 101.2</td>
</tr>
<tr>
<td>Urine 2</td>
<td>—, 5.00</td>
<td>—, 5.30</td>
<td>—, 106.0</td>
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<tr>
<td>Serum</td>
<td>4.50, —</td>
<td>4.29, —</td>
<td>95.3, —</td>
</tr>
<tr>
<td>Dopamine hydrochloride injection</td>
<td>4.00,1.00</td>
<td>3.70,1.03</td>
<td>92.5, 103.0</td>
</tr>
</tbody>
</table>
Table S2 Summary of various nanomaterial-based electrochemical sensors for DA and UA in presence of Ascorbic acid

<table>
<thead>
<tr>
<th>Sample Description</th>
<th>DA Concentration</th>
<th>UA Concentration</th>
<th>DA Concentration</th>
<th>UA Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretreated pencil graphite</td>
<td>0.15-15µM</td>
<td>0.3-150µM</td>
<td>0.033µM</td>
<td>0.12µM</td>
</tr>
<tr>
<td>Poly(acrylic acid)-multiwalled carbon-nanotube composite-covered glassy-carbon</td>
<td>40nM-3µM</td>
<td>0.3µM-10µM</td>
<td>20nM</td>
<td>110nM</td>
</tr>
<tr>
<td>Multi-walled carbon nanotube-chitosan/poly(amidoamine)/DNA nanocomposite modified gold electrode</td>
<td>0.2-10µM &amp; 10-100µM</td>
<td>0.5-100µM</td>
<td>0.03µM</td>
<td>0.07µM</td>
</tr>
<tr>
<td>Pt/reduced graphene oxide(Pt/RGO) modified glassy carbon electrode</td>
<td>10-170µM</td>
<td>10-130µM</td>
<td>0.25µM</td>
<td>0.45µM</td>
</tr>
<tr>
<td>Gold nanoparticle/choline (GNP/Ch) coated glassy carbon electrode</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>2,2’-azino-bis(3-ethylbenzthiazoline-6-sulfonic acid)(ABTS)-immobilized carbon nanotube (CNT) electrode</td>
<td>0.90-10µM &amp; 1.87-20µM</td>
<td>2.16-240µM &amp; 3.07-400µM</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Electrochemically preanodized clay-modified electrodes</td>
<td>0-6µM</td>
<td>0.5-10 &amp; 10-100µM</td>
<td>2.7nM</td>
<td>0.2µM</td>
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<tr>
<td>DNA/Poly(ρ-aminobenzensulfonic acid) composite bi-layer modified glassy</td>
<td>0.19–13 µM</td>
<td>0.4–23 µM</td>
<td>88 nM</td>
<td>0.19 µM</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Concentration Range</td>
<td>Quantity</td>
<td>Time</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------</td>
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<tr>
<td>9</td>
<td>RNA modified electrode</td>
<td>0.37 to 36 µM</td>
<td>0.2 µM</td>
<td>0.36 µM</td>
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<tr>
<td>10</td>
<td>poly(orthanilic acid)–multiwalled carbon nanotubes composite film-modified glassy carbon electrode</td>
<td>9–48 µM</td>
<td>6–55 µM</td>
<td>0.21 µM</td>
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<tr>
<td>11</td>
<td>multi-walled carbon nanotubes with methylene blue composite film-modified electrode</td>
<td>0.4–10.0 µM</td>
<td>2.0–20.0 and 20.0–200.0 µM</td>
<td>0.2 µM</td>
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<tr>
<td>12</td>
<td>Glassy carbon electrode modified with poly(dibromofluorescein)</td>
<td>0.2 to 200 µM L⁻¹</td>
<td>1.0 to 250 µM L⁻¹</td>
<td>0.03 µM L⁻¹</td>
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<tr>
<td>13</td>
<td>functionalized ordered mesoporous carbon/ionic liquid gel modified electrode</td>
<td>0.1 to 500 µM</td>
<td>0.1 to 100 µM</td>
<td>4.1 nM</td>
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<tr>
<td>14</td>
<td>Ionic Liquid Functionalized Graphene-Based electrode</td>
<td>1–400 µM</td>
<td>1–600 µM</td>
<td>0.679 µM</td>
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<tr>
<td>15</td>
<td>Indole-3-Carboxaldehyde Modified Glassy Carbon Electrode</td>
<td>10 µM -100 µM</td>
<td>10 µM -100 µM</td>
<td>1.70 µM</td>
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<tr>
<td>16</td>
<td>DNA/Pt Nanocluster Modified Electrode</td>
<td>1.1×10⁻⁷ to 3.8×10⁻⁵ M L⁻¹</td>
<td>3.0×10⁻⁷ to 5.7×10⁻⁵ M L⁻¹</td>
<td>3.6×10⁻⁸ M L⁻¹</td>
</tr>
</tbody>
</table>
References:


6 Yi-Kai, C.; Ming-Chang, Y. An 2,2′-azino-bis(3-ethylbenzthiazoline-6-sulfonic acid)-immobilized electrode for the simultaneous detection of dopamine and uric acid in the presence of ascorbic acid. *Bioelectrochemistry*, 2013, 91, 44–51.


8 Xiangqin, Lin.; Guangfeng, K.; Liping, Lu. DNA/Poly(p-aminobenzensulfonic acid) composite
bi-layer modified glassy carbon electrode for determination of dopamine and uric acid under coexistence of ascorbic acid. *Bioelectrochemistry, 2007, 70, 235–244.*


