

Supplemental Information to  
**Ultrasensitive electrochemiluminescence immunoassay for  
tumor marker detection using Ru-silica@nanoporous gold  
composite as labels**

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## 1 Optimal pH

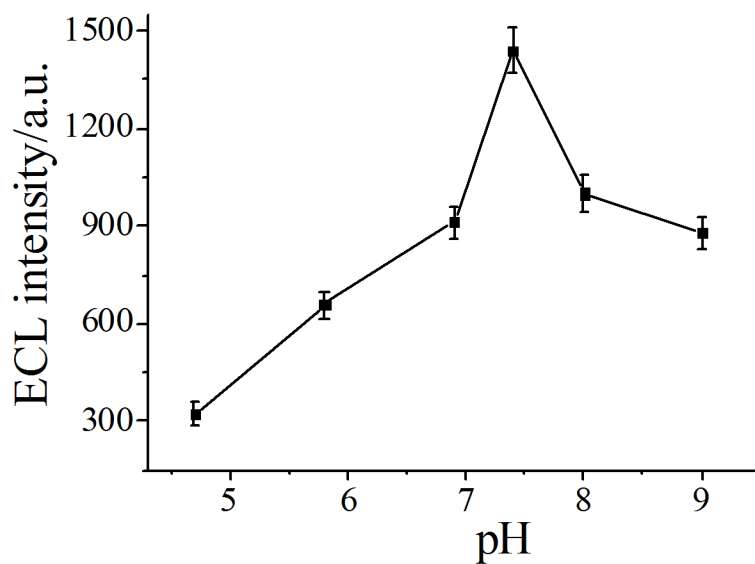


Figure S. 1 Effect of pH on ECL intensity

The pH value of substrate solution was an important factor to the ECL intensity. The ECL reaction was performed in the range from 4.7-9.0. The results showed that the optimum pH was 7.4 (Figure S.1).

## 2 Optimal deposition time

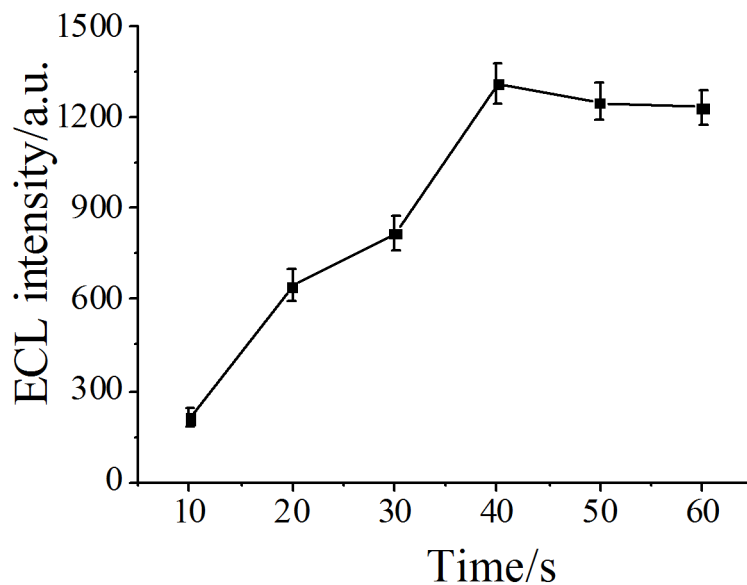


Figure S. 2 Effect of deposition time on ECL intensity

Electrodeposition is a facile approach for the deposition of gold nanoparticles onto the electrode surfaces. It is known that the deposition time is very important. Therefore, the effect of deposition time was studied in Figure S. 2. The results showed that the ECL intensity increased with the increase of deposition time and reached the maximum when deposition time was 40 s. So the optimal electrodeposition time was 40 s.

### 3 Reaction time with L-cysteine

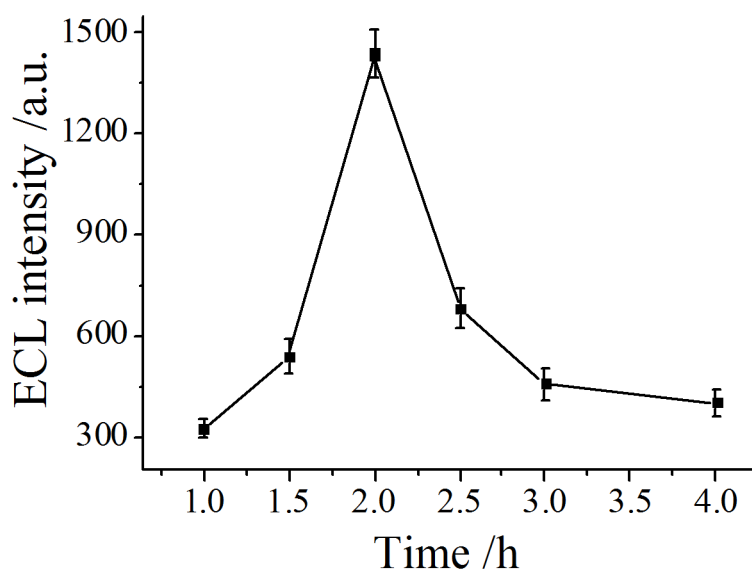


Figure S. 3 Effect of reaction time with L-cysteine

The ECL reaction was performed in 0.1 M L-cysteine solution, the effect of reaction time with L-cysteine on the ECL reaction was examined in the range from 1 to 4 h. The results showed that the optimum reaction time with L-cysteine was 2 h. (Figure S.3).

#### 4 Incubation time of Ab<sub>1</sub> and CEA

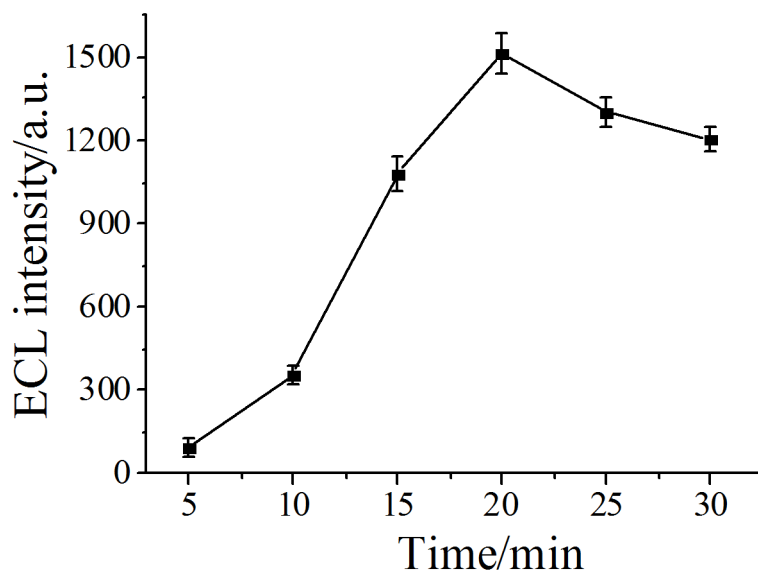


Figure S. 4 Effect of incubation time of Ab<sub>1</sub> and CEA

The effect of incubation time on the immunoreaction was performed. As shown in Figure S. 4, the effect of incubation time of Ab<sub>1</sub> and CEA was studied in the range from 5-30 min. The results showed that the ECL intensity of the immunosensor reached a maximum value in 20 min, indicating that the optimal incubation time of Ab<sub>1</sub> and CEA was 20 min.

### 5 incubation time of CEA and labeled-Ab<sub>2</sub>

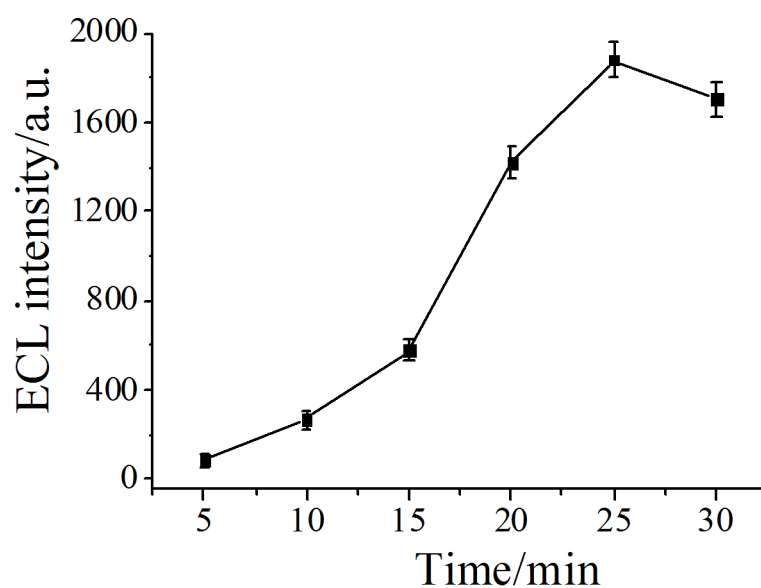


Figure S. 5 Effect of incubation time of CEA and labeled-Ab<sub>2</sub>

The effect of incubation time of CEA and labeled-Ab<sub>2</sub> on the immunoreaction was studied in the range from 5-30 min. As shown in Figure S. 5, the results showed that the ECL intensity of the immunosensor reached a maximum value in 25 min, indicating that the optimal incubation time of CEA and labeled-Ab<sub>2</sub> was 25 min.