Supporting Information

Catechol exerts *in situ* surface oxygen vacancy effect on BiOI: an innovative signal transduction mode for cathodic photoelectrochemistry

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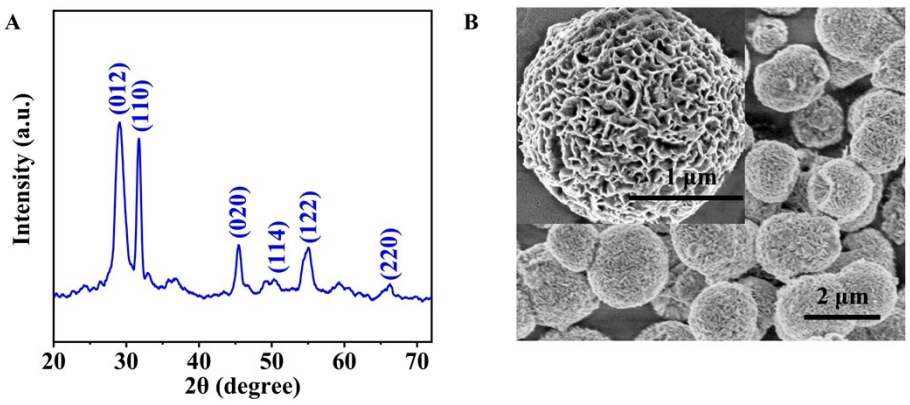

Fig. S1 (A) XRD pattern and (B) SEM image of BiOI.

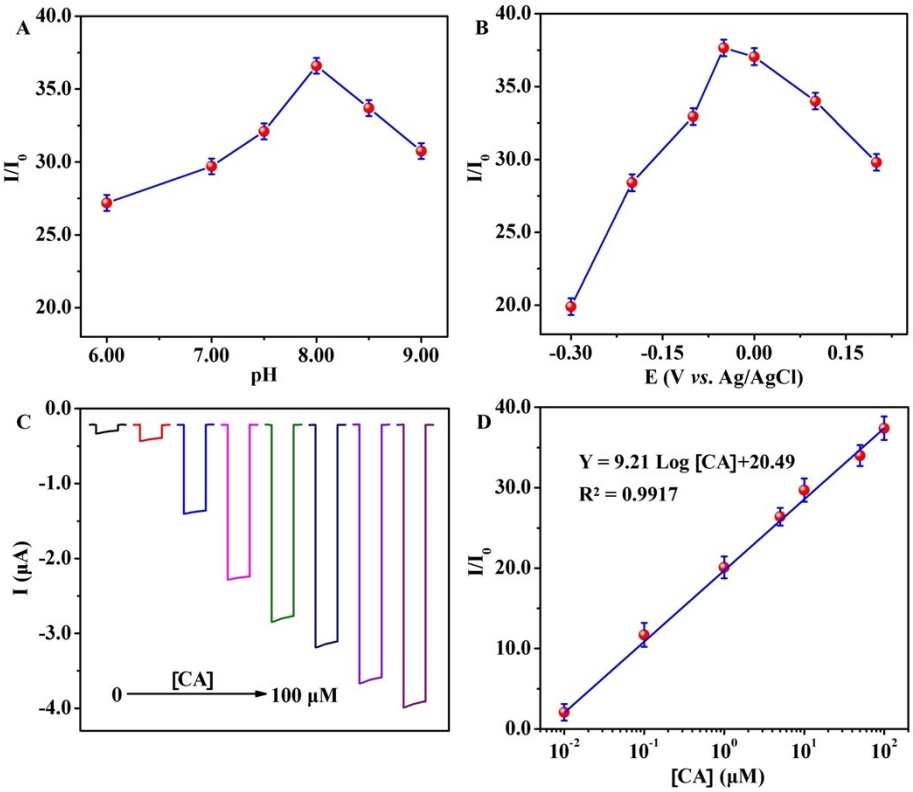

Fig. S2 (A) The effect of test buffer medium pH, and (B) applied bias on photocurrents of BiOI modified electrode to CA (10.0 μM). (C) Photocurrents of BiOI modified electrode when incubated with different concentrations of CA (from left to right, 0.0, 0.01, 0.1, 1.0, 5.0, 10.0, 50.0, and 100.0 μM). (D) The corresponding calibration curve of the photocurrent change (I/I_0) with CA concentrations on a logarithmic scale.

Fig. S3 The color changes of BiOI before and after reaction with CA.

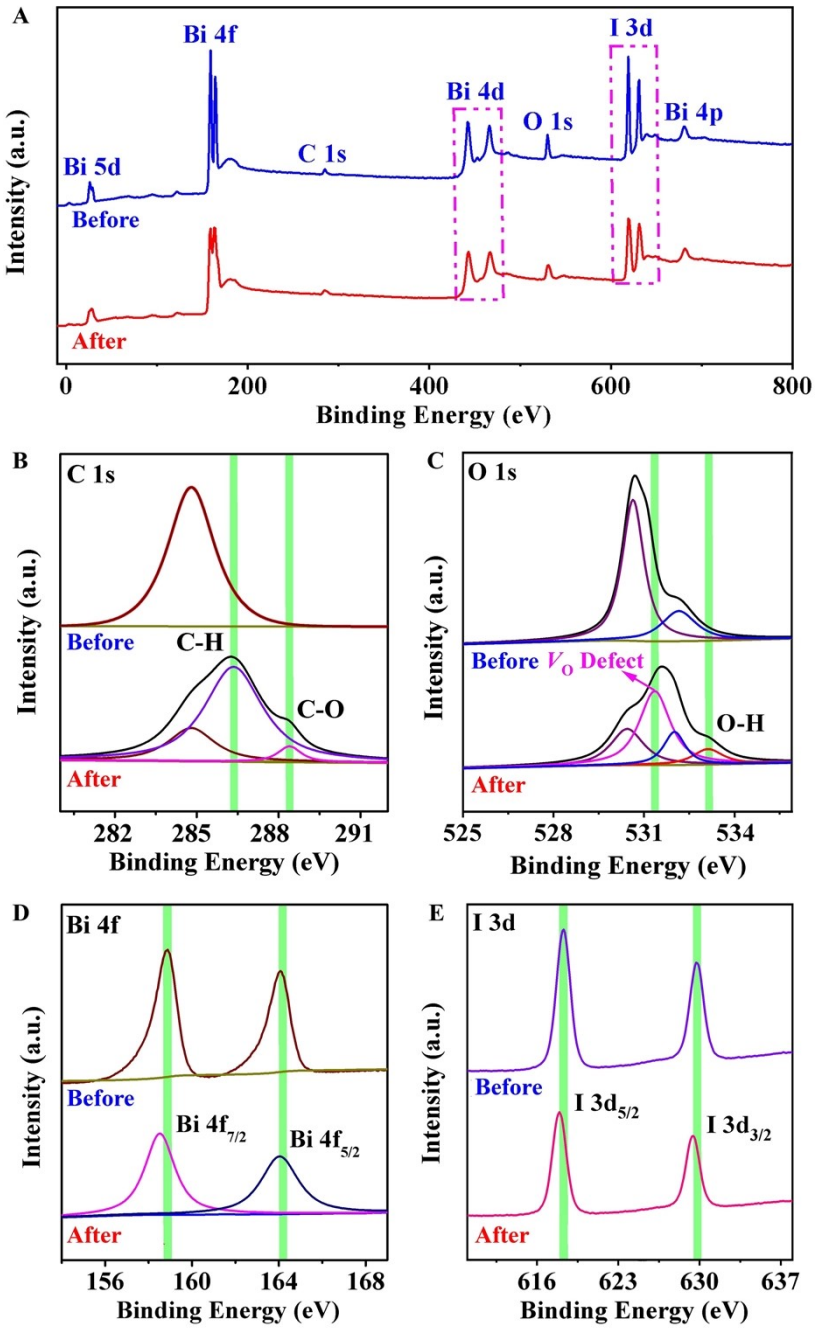

Fig. S4 (A) Survey XPS spectra of BiOI before and after reaction with CA, and corresponding high-resolution XPS spectra of (B) C 1s, (C) O 1s, (D) Bi 4f, and (E) I 3d.

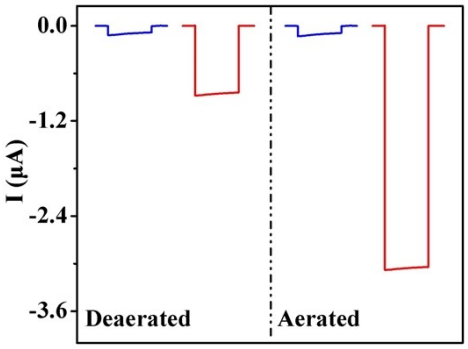

Fig. S5 Photocurrent responses of BiOI modified electrode before (blue line) and after (red line) reaction with 10.0 μM of CA in deaerated or aerated solutions.

Table S1. Excited state lifetimes of BiOI before and after reaction with CA

Sample	B_1	B_2	τ_1 (ns)	τ_2 (ns)	χ^2	τ_{avg} (ns)
Before	5431.27	3029.61	1.51	4.06	1.15	3.04
After	5621.32	2719.36	2.03	5.24	1.01	3.81

The fitting model is $I(t) = B_1 e^{-\tau/\tau 1} + B_2 e^{-\tau/\tau 2}$. The average fluorescence lifetime (τ_{avg}) is calculated according to the equation: $\tau_{avg} = (B_1\tau_1^2 + B_2\tau_2^2)/(B_1\tau_1 + B_2\tau_2)$, where B represent weighting parameter, τ is decay time.

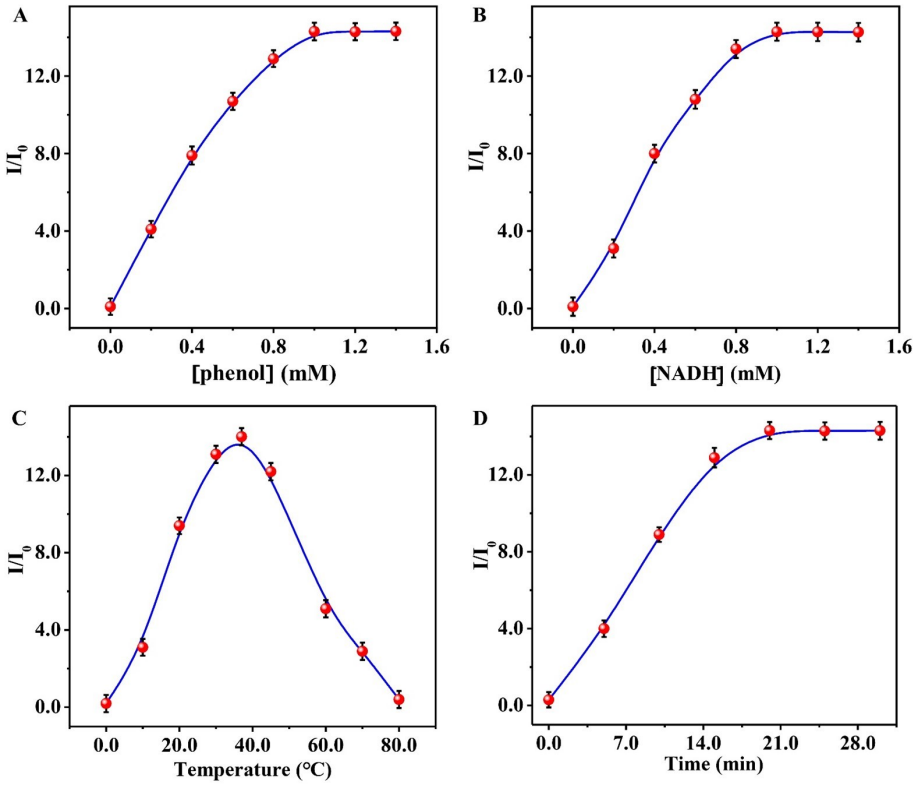

Fig. S6 The optimization of the (A) phenol concentration, (B) NADH concentration, (C) reaction temperature, and

(D) reaction time of the bioreaction for the PEC detection of TYR. The concentration of TYR was 0.1 U/mL.

As shown in Fig. S6, when the phenol concentration was 1.0 mM, the NADH concentration was 1.0 mM, the reaction temperature was 37 °C, and the bioreaction time was 20 min, the maximal photocurrent responses of the PEC detection system for TYR were obtained.

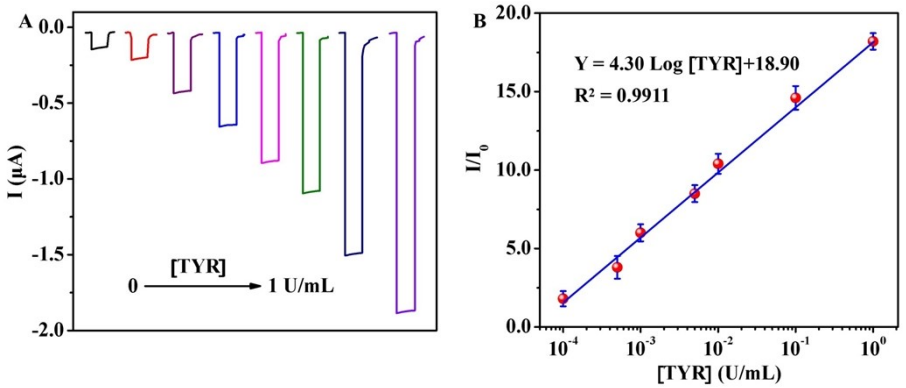

Fig. S7 (A) Photocurrents of the BiOI modified electrode to different concentrations (0.0, 0.0001, 0.0005, 0.001, 0.005, 0.01, 0.1, and 1.0 U/mL) of TYR. (B) The corresponding calibration curve of the photocurrent increment (I/I_0) with TYR concentrations on a logarithmic scale.

Table S2. Comparison with different methods for the detection of TYR

Method	Material	Linear range (U/mL)	LOD (U/mL)	Reference
SERS	*p*-TC/AuNPs	0.1 –100.0	0.07	[1]
BL	TYR/LH_2	0.1 –200.0	0.1	[2]
FL	Dopa/CQDs	2.3×10^{-2}–0.8	7.0×10^{-3}	[3]
FL	Au NCs	6.0×10^{-3}–3.6	6.0×10^{-3}	[4]
PEC	CdS NPs	Not given	0.1	[5]
PEC	BiOI	1.0×10^{-4} –1.0	2.5×10^{-5}	This work

Note: FL: Fluorescence; BL: Bioluminescence; SERS: Surface-enhanced Raman scattering.

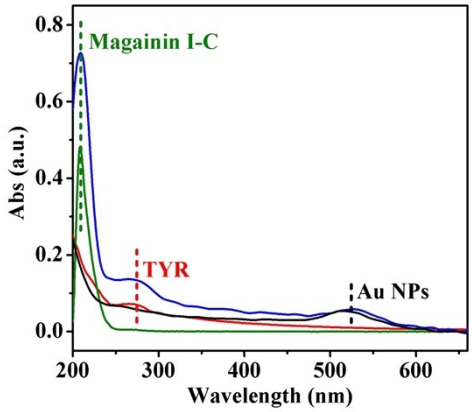

Fig. S8 UV-Vis absorption spectra of various solutions: Au NPs (black line); TYR (red line); Magainin I-C (green line); Au NPs/TYR/Magainin I-C bioconjugates (blue line).

The characteristic absorption peaks for Au nanoparticles (NPs), TYR, and Magainin I-C could be seen in the Au NPs/TYR/Magainin I-C bioconjugates (Fig. S8), which confirmed that TYR and Magainin I-C were successfully fixed to Au NPs and subsequently used as catalytic label (for signify the detection) and recognition element for *E. coli* O157:H7.

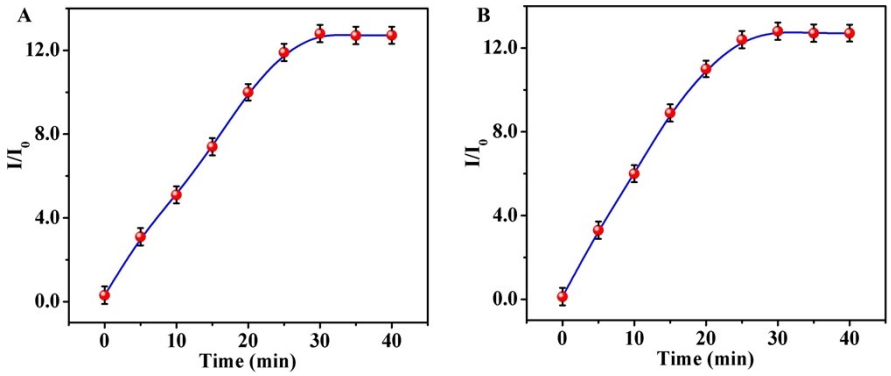

Fig. S9 The effect of the incubation time of (A) *E. coli* O157:H7 and Magainin I, (B) *E. coli* O157:H7 and Au NPs/TYR/Magainin I-C bioconjugates on the responses of the PEC immunoassay. The concentration of *E. coli* O157:H7 was 1.0×10^5 CFU/mL.

Similarly, as shown in Fig. S9, when both Magainin I and *E. coli* O157:H7, *E. coli* O157:H7 and Au NPs/TYR/Magainin I-C bioconjugates were incubated for 30 min, the best PEC detection results for E. coli O157:H7 were obtained.

Table S3. Comparison with different methods for the detection of *E. coli* O157:H7

Method	Material	Linear range (CFU/mL)	LOD (CFU/mL)	Reference
Colorimetry	CNTs	1.0×10^2–1.0×10^5	1.0×10^2	[6]
CL	Luminol	4.3×10^3–4.3×10^5	1.2×10^3	[7]
ECL	Ru complex	5.0×10^2–5.0×10^5	1.2×10^2	[8]
EC	Fc	1.0×10^3–1.0×10^7	1.0×10^3	[9]
EC	——	1.0×10^3–1.0×10^8	1.0×10^3	[10]
EC	AuNPs	1.0×10^2–1.0×10^5	1.0×10^2	[11]
PEC	BiOI	5.0–1.0×10^6	3.0	This work

CL: Chemiluminescence; ECL: Electrochemiluminescence; EC: Electrochemistry.

Table S4. Spiked recovery tests for *E. coli* O157:H7 in skim milk

Spiked samples	Spiked *E. coli* O157:H7 (CFU/mL)	Found (CFU/mL)	Recovery (%)
1	0.0	Not found	——
2	50.0	48.50	97.0
3	5.0×10^3	5.17×10^3	103.4
4	5.0×10^5	4.76×10^5	95.2

Table S5. Comparison of results for skim milk samples using the proposed PEC sensor and ELISA kit

Spiked samples	Method; concentration: mean±SD (RSD) (CFU/μL, n=3)		t_{exp}
	ELISA	PEC	
1	4.06±0.23	3.97±0.27	1.01
2	4.52±1.15	4.61±1.19	1.21
3	5.49±0.63	5.37±0.59	0.97
4	5.73±2.01	5.79±1.94	1.14
5	6.11±1.41	6.02±1.48	0.89
6	6.54±0.91	6.61±0.84	1.03
7	7.02±0.33	6.94±0.28	1.64

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