Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B.

Supporting Information

Cascade amplified colorimetric immunoassay based on an integrated multifunctional composite with catalytic coordination polymer for prostate specific antigen detection

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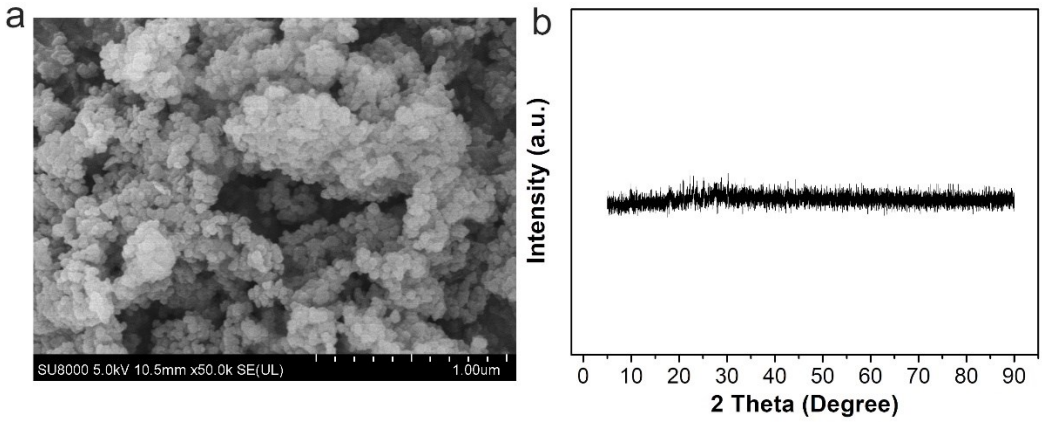

Figure S1. SEM image (a) and powder XRD pattern (b) of FeCPs.

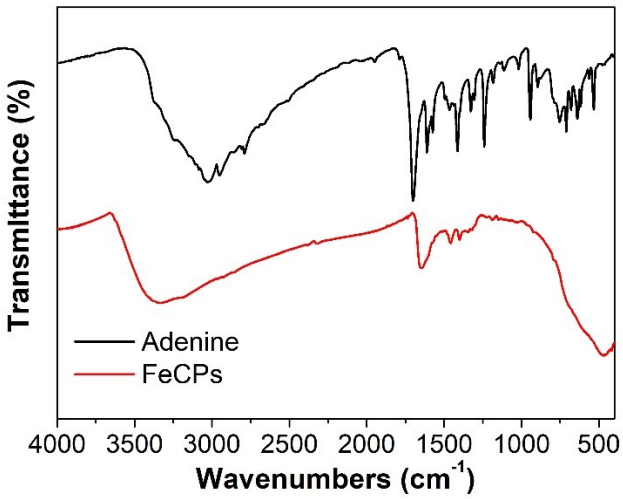

Figure S2. FTIR spectra of adenine and FeCPs.

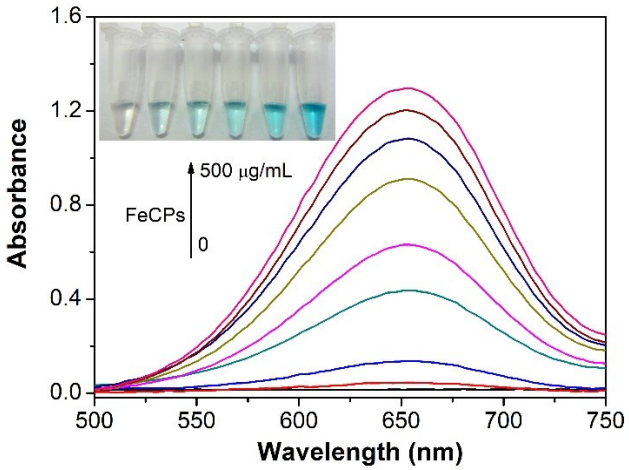

Figure S3. Absorption spectra of TMB solution in the presence of H_2O_2 and FeCPs with different concentration (from 0 to 500 μg/mL).

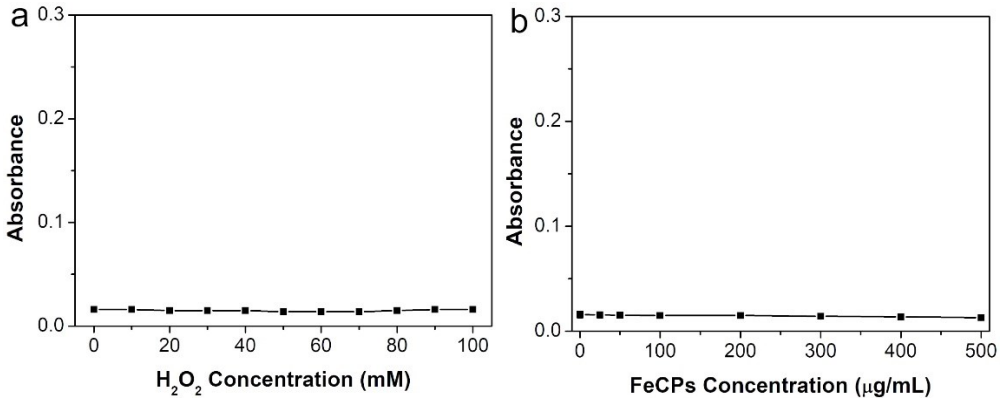

Figure S4. Effects of different concentrations of H_2O_2 (a) and FeCPs (b) on the absorbance of TMB.

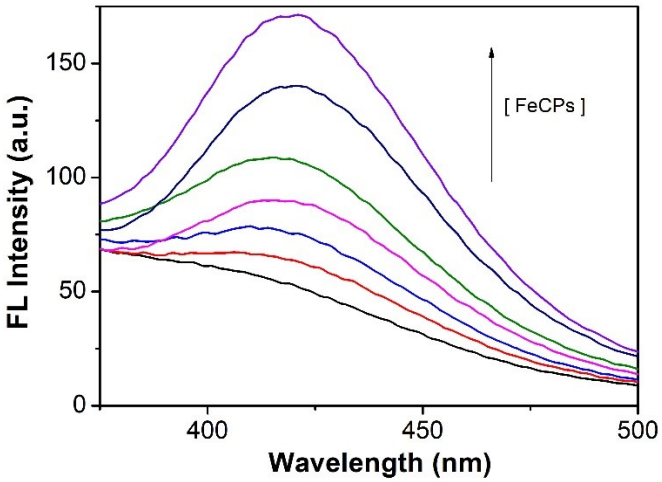

Figure S5. Emission spectra of terephthalic acid (TA) in the presence of H_2O_2 (2 mM) and FeCPs with concentration from 0 to 20 μg/mL.

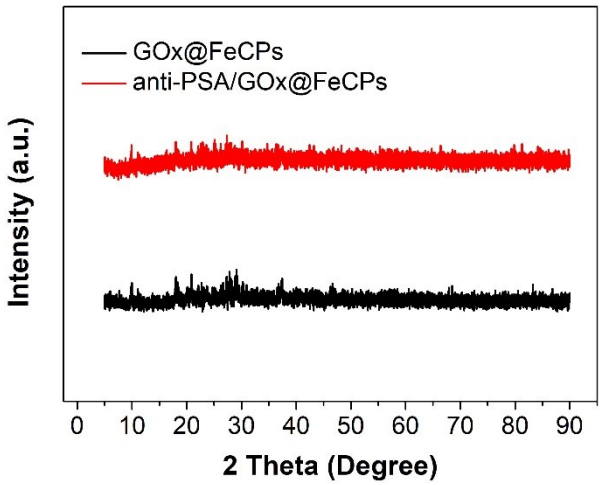

Figure S6. Powder XRD pattern of GOx@FeCPs and anti-PSA/GOx@FeCPs.

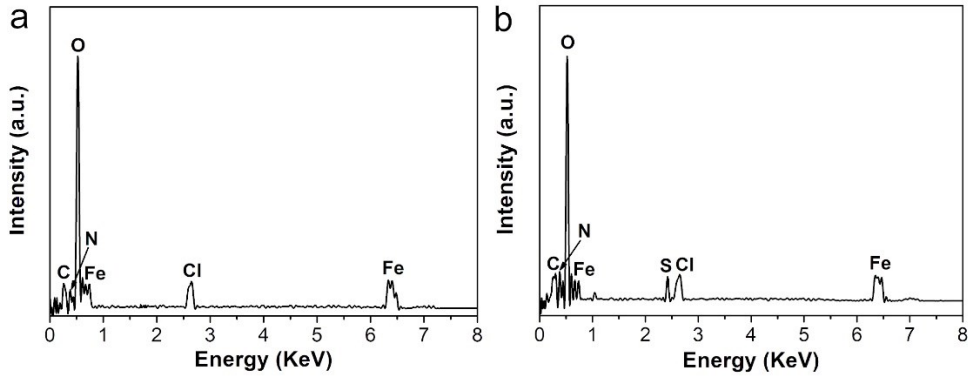

Figure S7. EDS spectra of FeCPs (a) and GOx@FeCPs (b).

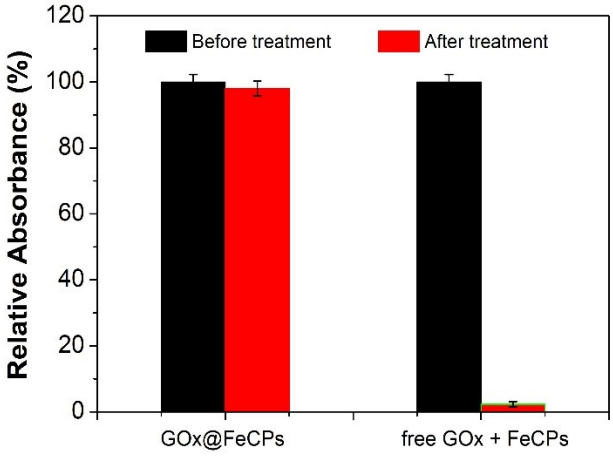

Figure S8. Relative absorbance of GOx@FeCPs and the mixture of free GOx and FeCPs before (black columns) and after (red columns) treating with excessive SDS.

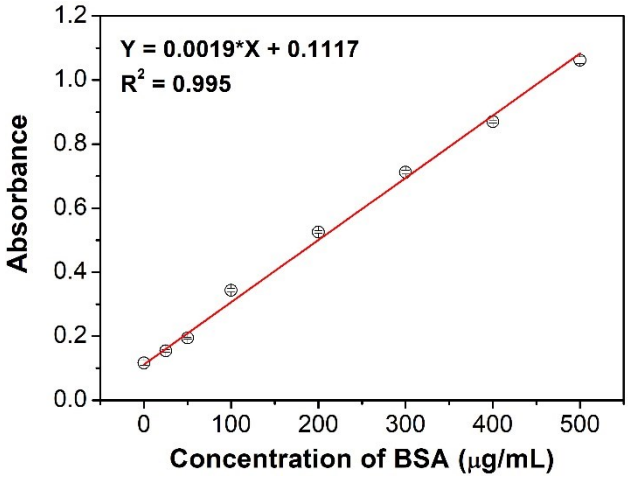

Figure S9. The calibration curve of the absorbance of BCA reagent at 560 nm as a function of BSA concentrations.

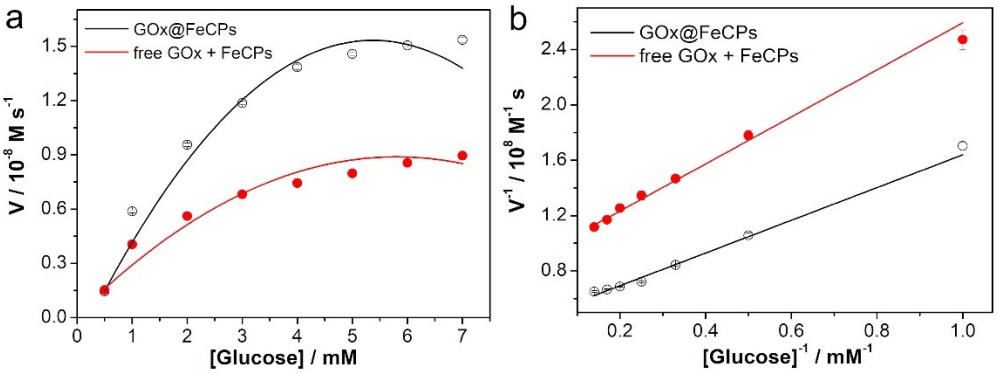

Figure S10. Steady-state kinetic assays (a) and double-reciprocal plots (b) of GOx@FeCPs and the mixture system of free GOx and FeCPs.

Table S1. Kinetic data for GOx@FeCPs and the mixture system of free GOx and FeCPs

Catalyst	Substrate	K_m (mM)	V_{max} (10^{-8} M s^{-1})	K_{cat} (s^{-1})
free GOx + FeCPs	Glucose	1.98	1.12	43.78
GOx@FeCPs	Glucose	2.09	2.19	93.25

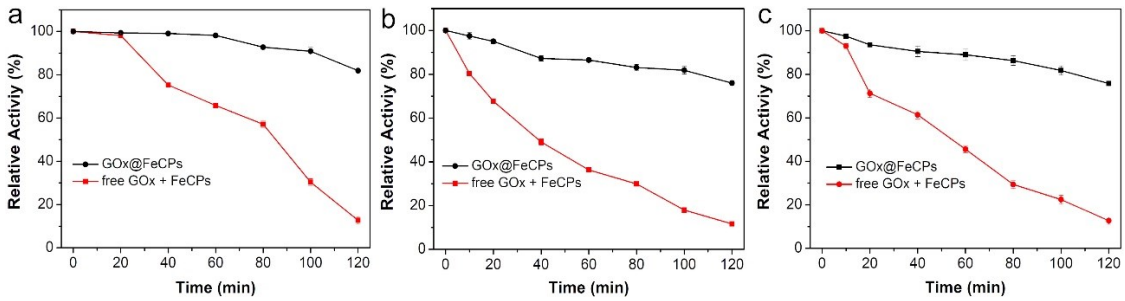

Figure S11. Relative activity of GOx@FeCPs and the mixture system of free GOx and FeCPs after treating for 120 min with 60 ℃ (a), 8 M urea (b) and 80% ethanol (c).

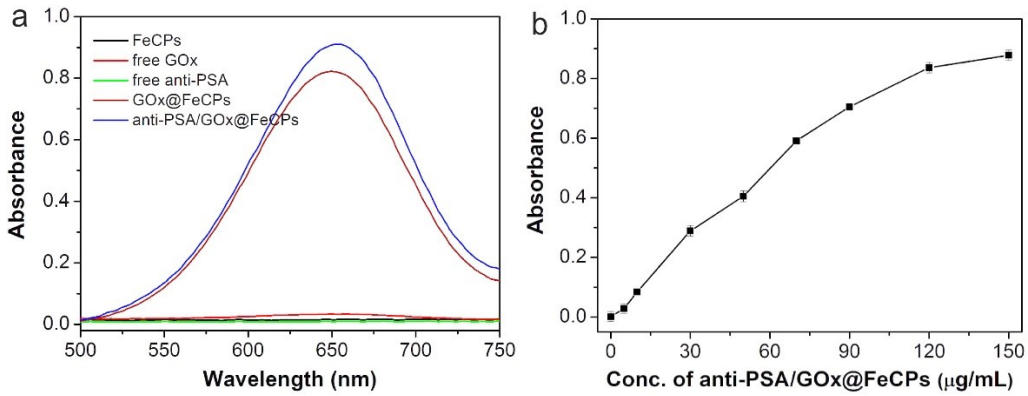

Figure S12. (a) Absorbance spectra of TMB solution with glucose in the presence of FeCPs, free GOx, free anti-PSA, GOx@FeCPs, or anti-PSA/GOx@FeCP. (b) Absorbance of TMB solution with glucose due to the immunoassay using different concentrations of anti-PSA/GOx@FeCPs as a detection antibody.

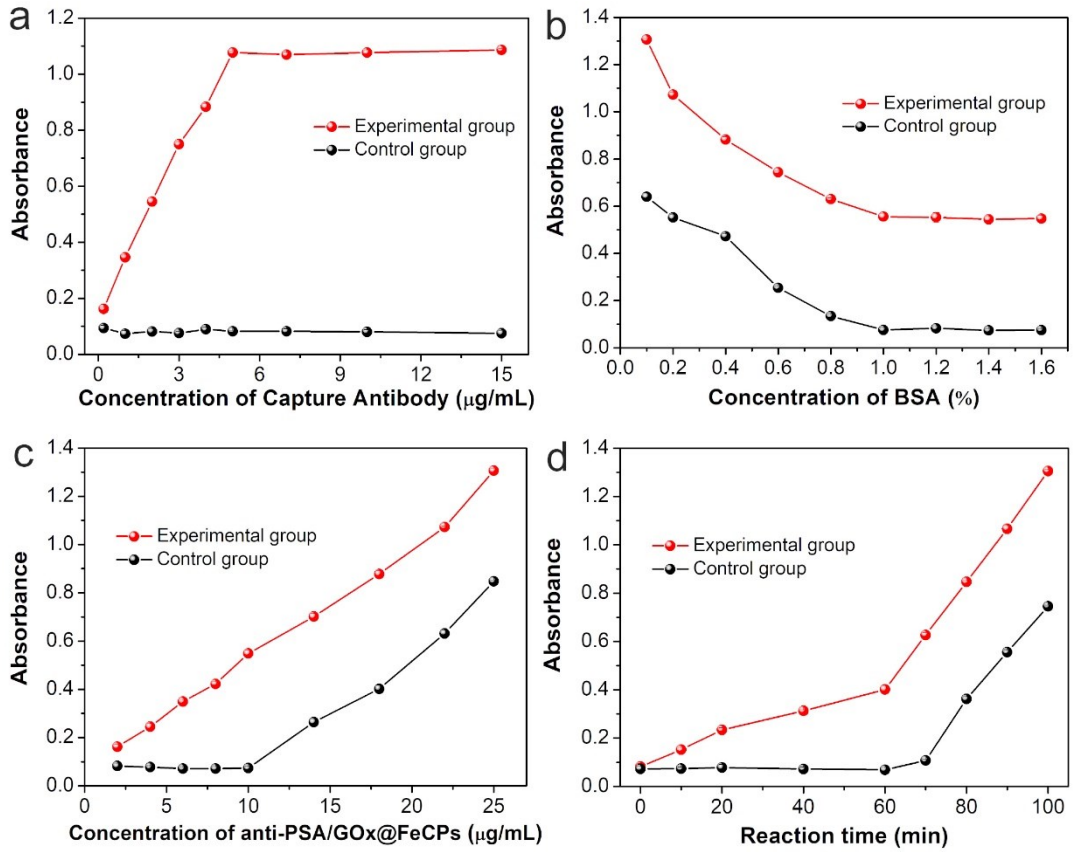

Figure S13. Effects of the concentrations of capture antibody (a), blocking agent BSA (b), anti-PSA/GOx@FeCPs (c), and reaction time (d) on the immunoassays with (red, as experimental group) and without (black, as control group) antigens.

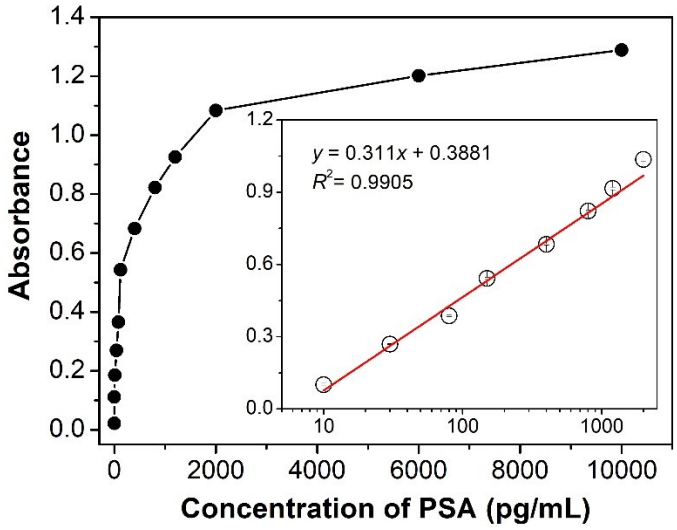

Figure S14. Absorbance of oxTMB at 650 nm produced in the immunoassays toward PSA at various concentrations (from 0 to 10000 pg/mL). Inset is the calibration curve of the absorbance of oxTMB versus PSA concentration (from 10 to 2000 pg/mL).

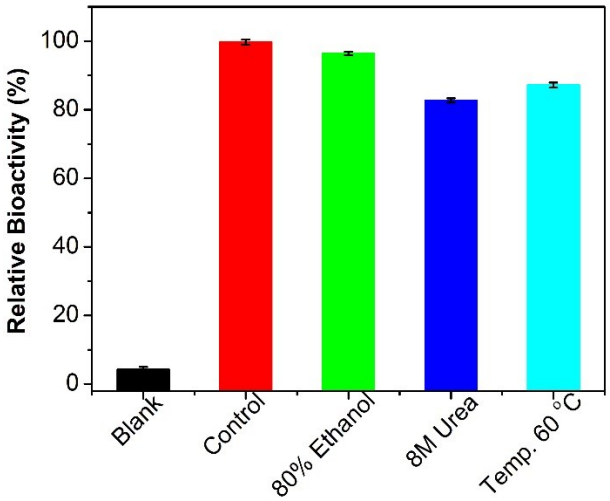

Figure S15. Relative bioactivity of anti-PSA/GOx@FeCPs after treating with for 120 min with high temperature (60 ℃), 8 M urea and 80 % ethanol.

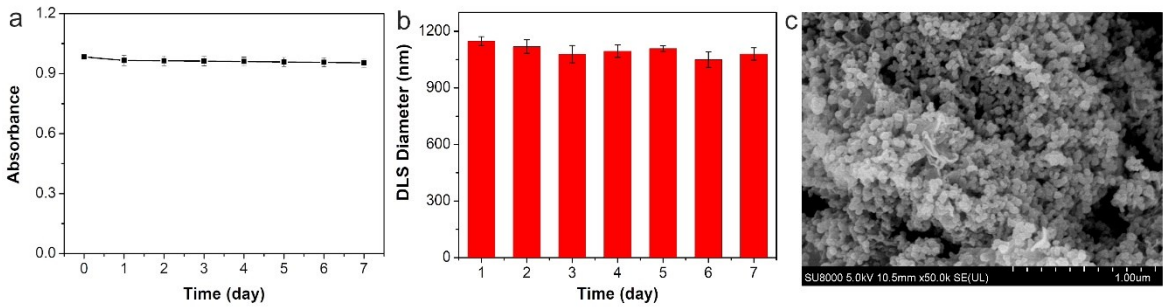

Figure S16. (a) Absorbance of oxTMB produced by immunoassay using the anti-PSA/GOx@FeCPs after keeping in HEPES buffer (100 mM, pH = 7.4) for 7 days at room temperature. The hydrodynamic diameters (b) and SEM image (c) of anti-PSA/GOx@FeCPs after keeping in HEPES buffer (100 mM, pH = 7.4) for 7 days at room temperature.

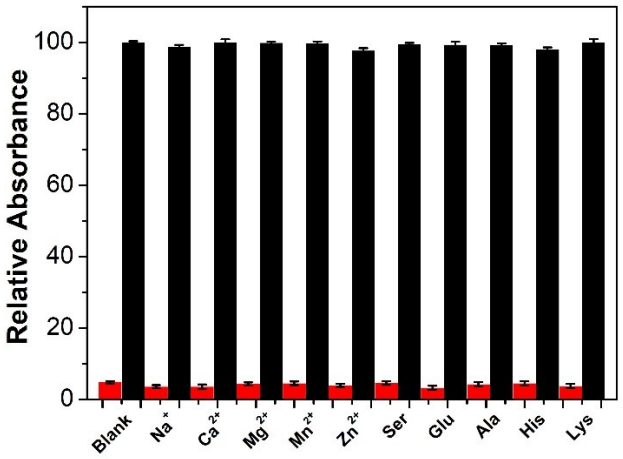

Figure S17. Effects of metal ions and biological species on the colorimetric immunoassay based on anti-PSA/GOx@FeCPs as a detection antibody. Black bars represent the addition of single interfering material (100 μM). Red bars represent the addition of the mixture of PSA (1500 pg/mL) and interfering materials (100 μM).

Table S2. Comparison of various colorimetric immunoassays for PSA detection.

Antibody labels	Chromogenic reagent	Linear range (pg/mL)	LOD (pg/mL)	Refs
Alkaline phosphatase (ALP)	TMB	100 - 20 000	50	1
GOx coated AuNP	Squaric acid	1 - 30 000	0.5	2
AuNP@PtNP	TMB	5 - 500	2.9	3
AgNP	TMB	2 - 64	0.165	4
GOx-conjugated avidin	KI/starch	1 - 1×10^6	0.46	5
ALP	Cu(I)-bicinchoninic acid complex	0.5 - 25	0.38	6
anti-PSA/GOx@FeCPs	TMB	10 - 2000	1.03	This work

Table S3. Determination of PSA in serum sample

Added (pg/mL)	Detected (pg/mL)	Recovery (%)	RSD (n=3, %)
5	5.43	108.56	1.59
450	452.73	100.61	2.38
900	899.40	99.93	1.12
1200	1204.40	100.37	1.45

References

1. Z. Gao, L. Hou, M. Xu and D. Tang, *Sci. Rep.*, 2014, **4**, 3966.
2. W. Lai, D. Tang, J. Zhuang, G. Chen and H. Yang, *Anal. Chem.*, 2014, **86**, 5061-5068.
3. Z. Gao, M. Xu, M. Lu, G. Chen and D. Tang, *Biosens. Bioelectron.*, 2015, **70**, 194-201.
4. J. Li, Z. Gao, H. Ye, S. Wan, M. Pierce, D. Tang and X. Xia, *Chem. Commun.*, 2017, **53**, 9055-9058.
5. Y. Liu, L. Lei and Z. Zhang, *Sens. Actuators B-Chem.*, 2017, **248**, 195-200.
6. L. Lei, W. Xie, Z. Chen, Y. Jiang and Y. Liu, *Sens. Actuators B-Chem.*, 2018, **273**, 35-40.