Electronic Supplementary Material (ESI) for Analyst.

Fabrication of high-performance cell-imprinted polymers based on AuNPs/MXene composites via metal-free visible-light induced ATRP

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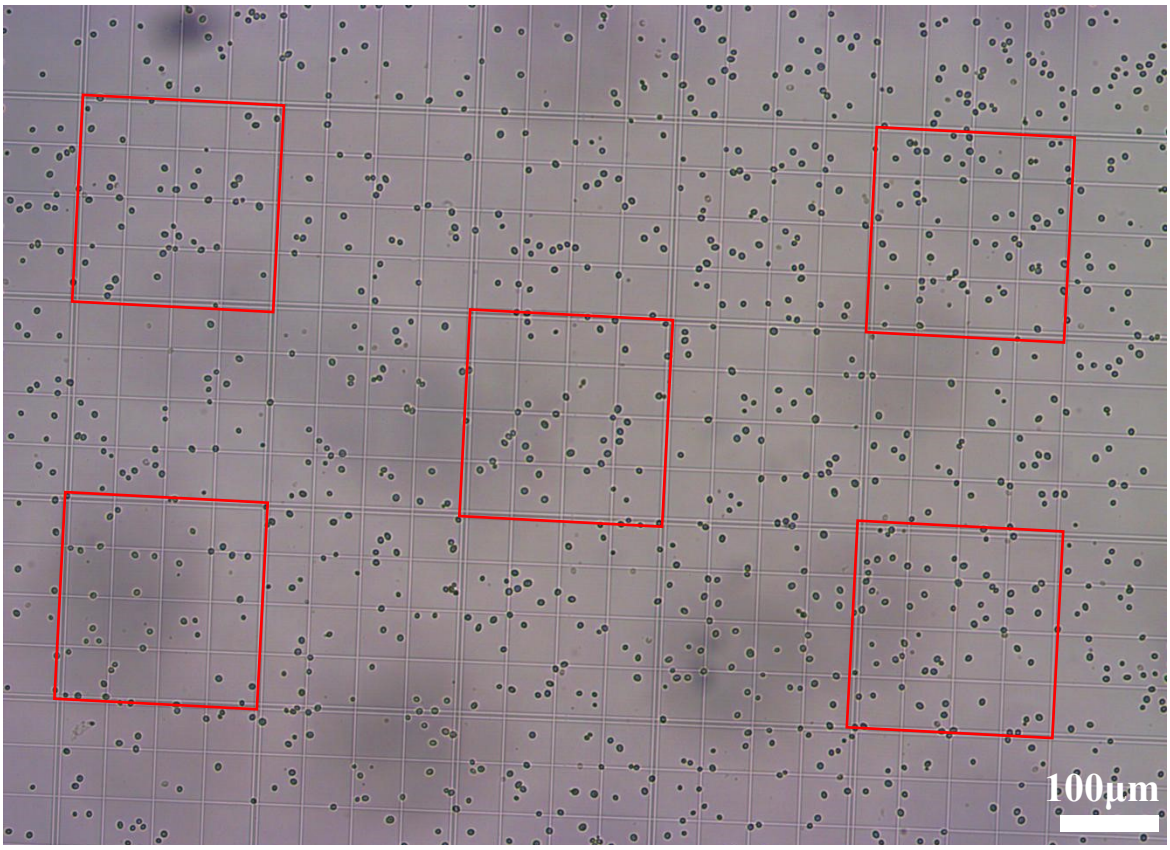

Fig. S1 The microscope image of yeast cells on a cell counting plate. The red box was the counting area

Fig. S1 was the microscopic image when the yeast cell solution was dripped onto a cell counting plate. There were two cells counting chambers on the cell counting plate. One counting chamber was composed of 25 large squares, and each large square was divided into 16 small squares, such as the red box in Fig. S1, thus, each counting chamber was made up of 400 small squares. The side length of the counting chamber was 1 mm, so the area of the counting chamber was 1 mm^2. After the cover glass was covered on the surface of the counting plate, the height of the counting chamber was 0.1 mm, so the volume of a counting chamber was 0.1 mm^3. Typically, five large squares (80 small squares) were selected as the counting areas, as shown in Fig. S1. The amount of cells in these squares need to be counted carefully under the ordinary optical microscope. By using the followed formula, the amount of cells per milliliter could be calculated.

$$A = \frac{B}{80} \times 400 \times 10 \times 1000C$$

Where A was the amount of cells per milliliter, B was the number of cells in the counting areas, C was the multiple of cells diluted. For example, 6 μL 0.4 mg/mL yeast cell solution was dripped onto the counting

plate, the value of C was 1, by counting the number of the cells on the image three times, the average B was 200 cells, A was 1.0×10^7 cells/mL by calculating. That was to say, the number concentration of 0.4 mg/mL yeast cell was 1.0×10^7 cells/mL.

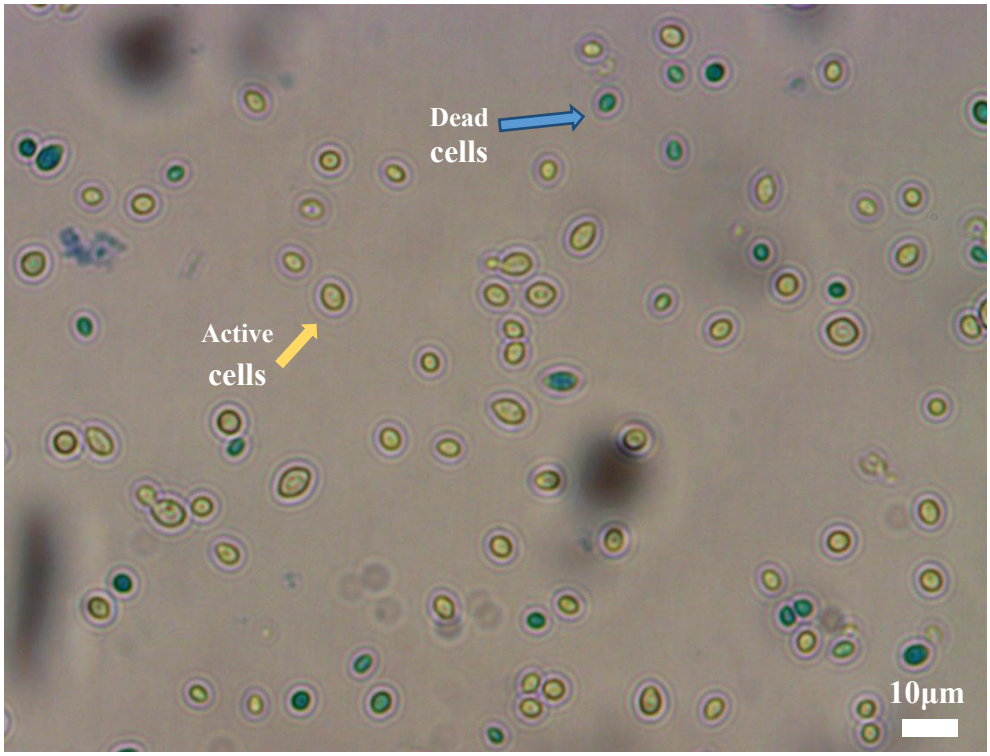

Fig. S2 The microscope image of yeast cells after staining by methylene blue

Methylene blue (MB, 0.01g) and trisodium citrate dihydrate (2 g) were dissolved in ultrapure water (100mL) to achieve the staining solution. Then the solution was mixed with an equal volume of the yeast sample (~2×10^7 cells/mL in PBS). After dying for five minutes, the mixture was loaded into a glass slide. The samples were examined microscopically under visible light. As displayed in Fig. S2, the dead yeast cells were dyed blue, active yeast cells were pale yellow. This might be attributed to a sort of reductase in active yeast cells, which could reduce methylene blue. However, the reductase in dead yeast cells was inactivated and did not decolorize MB, so the dead yeast cells was dyed blue.[1]

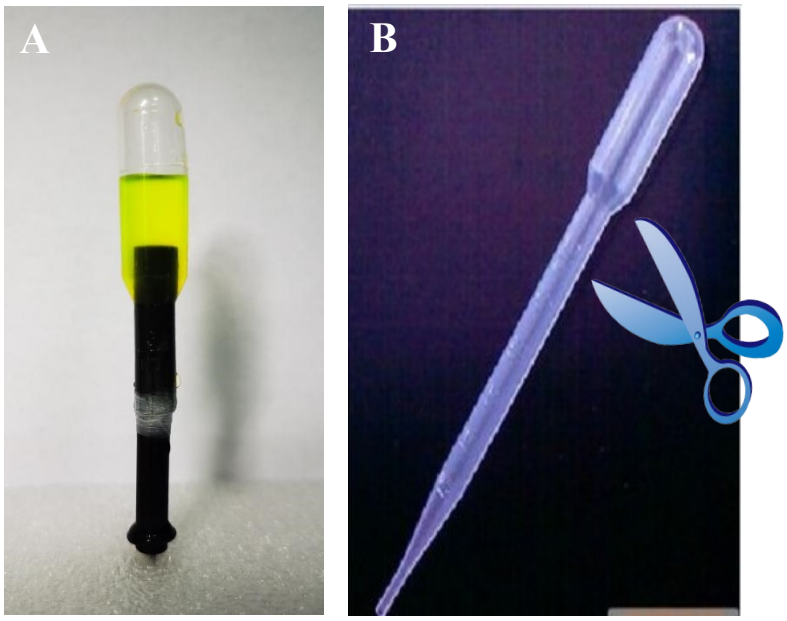

Fig. S3 The photographs (A) of electrode (For observation, the concentration of fluorescein in the polymerization solution was magnified 10 times) and the preparation scheme (B) of microreactor.

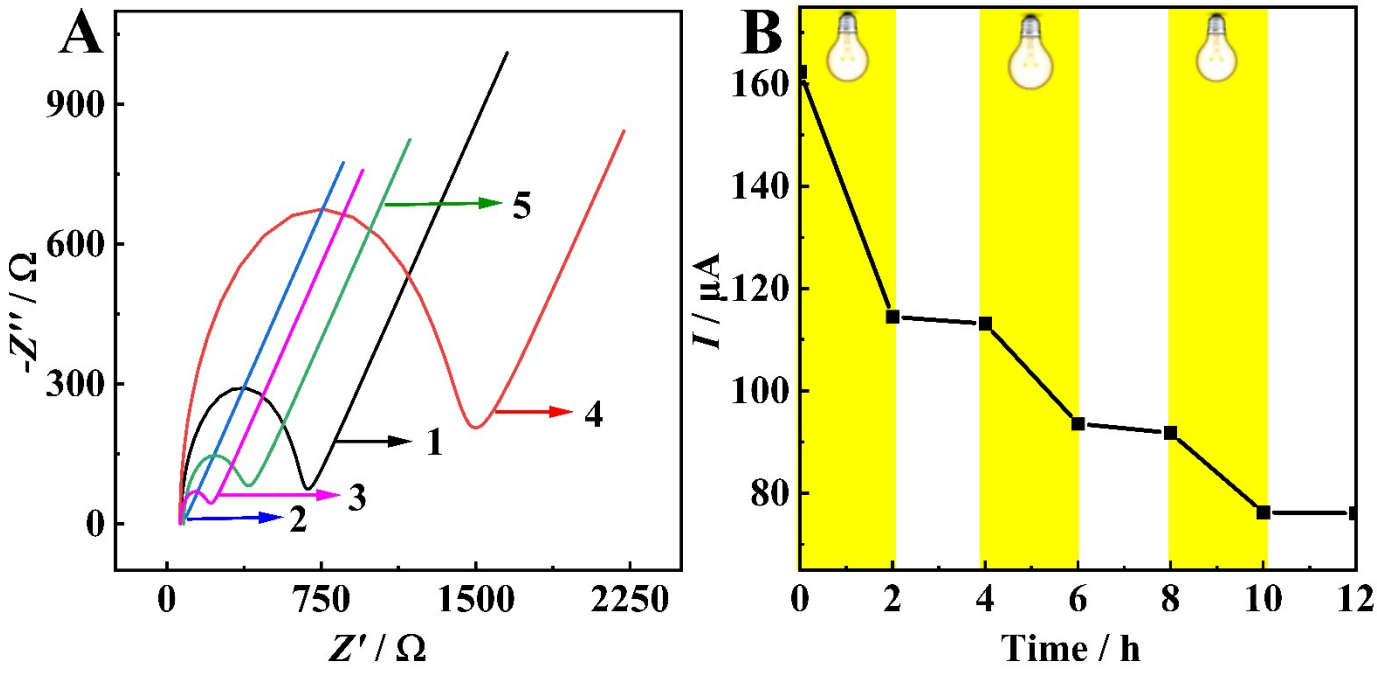

Fig. S4 The EIS (A) characterization of the stepwise modified electrodes (1-bare GCE, 2-AuNPs/$Ti_3C_2T_x$/GCE, 3-Br/AuNPs/$Ti_3C_2T_x$/GCE, 4-Polymer/AuNPs/$Ti_3C_2T_x$/GCE, 5-CIPs/AuNPs/$Ti_3C_2T_x$/GCE) in PBS containing 5 mmol/L $[Fe(CN)_6]^{3-/4-}$ and 0.1 mol/L KCl. (B) The "on-

off" experiment. (Yellow regions were the visible light "on" and white regions were the visible light "off").

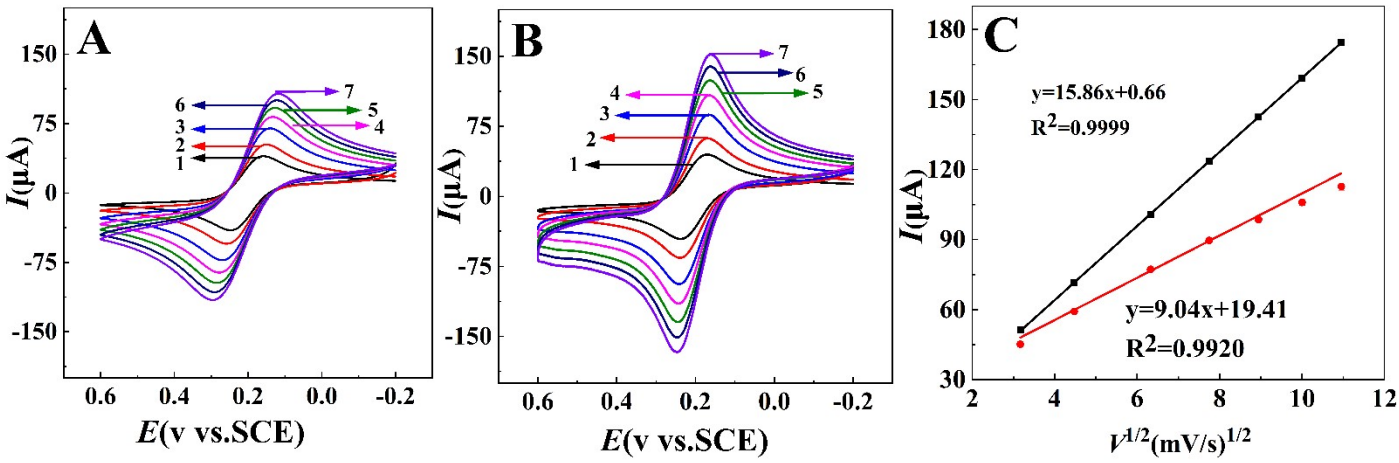

Fig. S5 The CV curves of bare GCE (A) and AuNPs/$Ti_3C_2T_x$/GCE (B) at different scan rates (curves 1 to curve 7 were 10、20、40、60、80、100 and 120 mV/s). (C) Plots of peak current with square root of scan rates (red-GCE; black-AuNPs/$Ti_3C_2T_x$/GCE)

In order to explore the effect of AuNPs/$Ti_3C_2T_x$ composites on the surface area of the electrode, bare GCE electrode and AuNPs/$Ti_3C_2T_x$/GCE electrode were characterized by CV at different scanning rates in Fig. S5. According to the Randles-Sevcik equation, $I_p = 2.69\times10^5 n^{3/2} A D^{1/2} C v^{1/2}$, when n, D, and C were the same, the slope of the linear equation (I_p *vs.* $v^{1/2}$) was proportional to the effective area (A) of the electrode.[42] By calculation, the slope of the AuNPs/$Ti_3C_2T_x$/GCE electrode was approximately 1.75 times that of the bare GCE, further proving that the actual effective surface area of GCE was enlarged by AuNPs/$Ti_3C_2T_x$ composites.

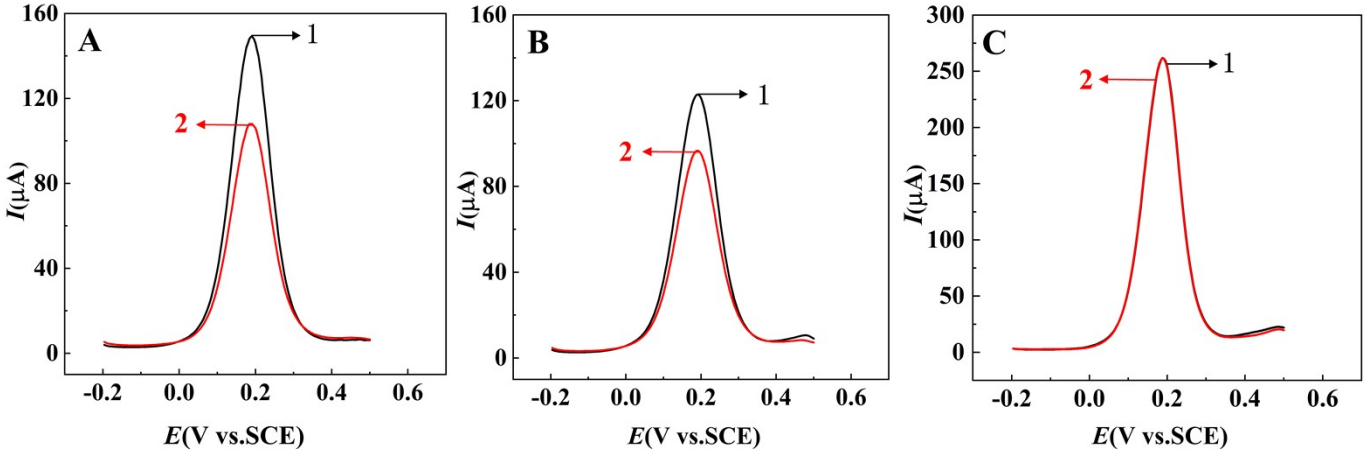

Fig. S6 The DPV signal response of CIPs/AuNPs/$Ti_3C_2T_x$/GCE (A), CIPs/AuNPs/GCE(B) and AuNPs/$Ti_3C_2T_x$/GCE (C). 1-before, 2-after incubating in yeast cells solution (1.00×10^4 cells/mL)

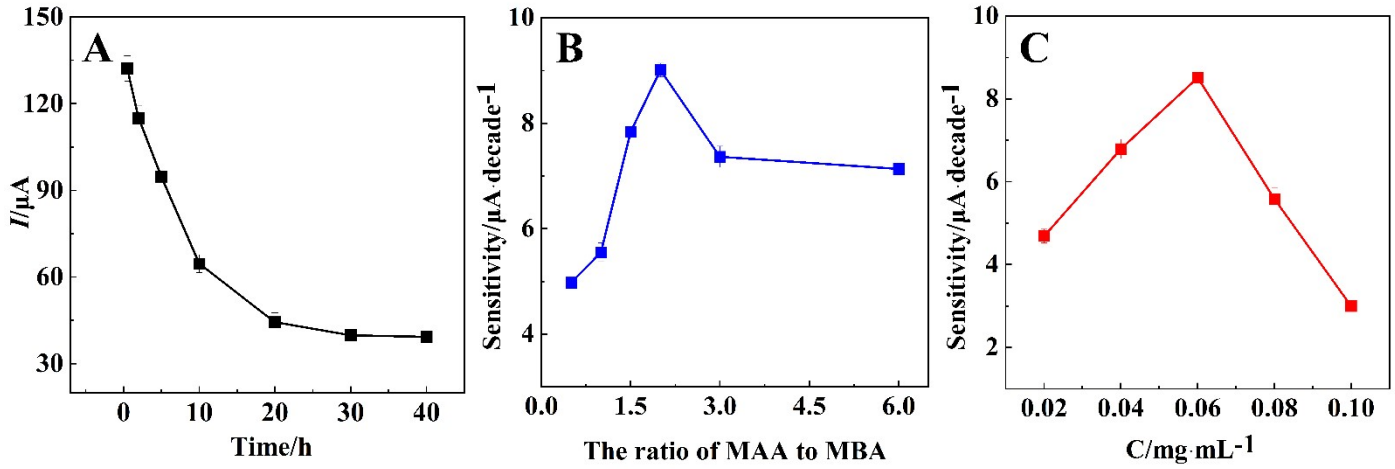

Fig. S7 The effect of illumination time (A) on the performance of Polymer/AuNPs/$Ti_3C_2T_x$/GCE, the ratio of MAA to MBA (B) and the cells concentration (C) on the performance of CIPs/AuNPs/$Ti_3C_2T_x$/GCE.

Table S1 Comparison of CIPs/AuNPs/$Ti_3C_2T_x$/GCE and similar sensors *

Materials	Analyte	Detection method	Linear range (cells/mL)	Detection limit (cells/mL)	References
Marine-mussel-inspired polydopamine (PDA) coating	yeast cells	Chronopotentiometry	1×10^2 ~ 1.5×10^3	50	2
MIPs based on		Impedance	3×10^1 ~	30	3

polyurethane (PU)	spectroscopy	1×10^5		
MIPs based on screen-printed carbon electrodes (SPCEs)	Thermal resistance method	1.0×10^2 ~ 1.0×10^7	22	[4]
MIP coated quartz crystal microbalances (QCM)	Fluorescence	1×10^4 ~ 1×10^5	1×10^4	[5]
CIPs/AuNPs/$Ti_3C_2T_x$/GCE	DPV	1.00×10^2 ~ 1.00×10^9	20	This paper

*For facilitate comparison, the data units were converted

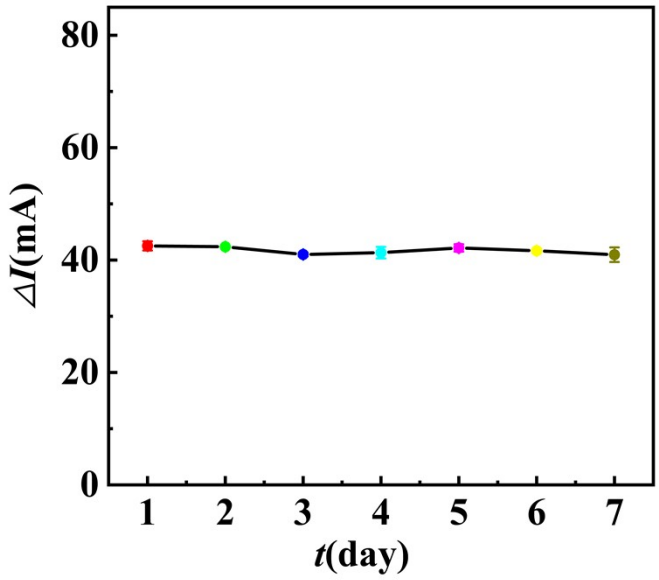

Fig. S8 Regeneration of the same CIPs/AuNPs/$Ti_3C_2T_x$/GCE

Table S2 Detection of yeast cells in real samples (n=3)

Analyze	Original sample concentration* (cells/mL)	Added (cells/mL)	Detection concentration (cells/mL)	Recovery （%）	RSD （%）
Yeast cells	9.00×10^3	9.00×10^3	1.79×10^4	99.6	3.71
		1.80×10^4	2.66×10^4	96.9	3.61
		4.50×10^4	5.44×10^4	104.8	4.97

*The concentration of yeast cells in SBS was detected by cell counting method.

References

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