Electronic supplementary information

Rapid detection of *Saccharomyces cerevisiae* with Boronic Acid-Decorated Multivariate Metal-Organic Frameworks and Aptamer

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Aptamer screening

A toggle-cell systematic evolution of ligands by exponential enrichment (SELEX) method was used to select aptamer for *S. cerevisiae*. The specific steps include microbial isolation, DNA extraction and Sanger sequencing, pangenome analysis, sequential toggle-cell SELEX operation, PCR amplification and determination of binding affinity. The dissociation constants (K_d) and maximum binding intensity (B_{max}) of the aptamer used in this study were 4.936±0.121 nM and 0.993±0.048 nM, respectively, according to fluorometer analysis.

Direct detection of *S. cerevisiae* in distilled yeast samples

Distilled yeast (10 g) was added to a triangular flask containing glass beads and 90 mL of sterile physiological saline and incubated for 30 min (160 rpm/min). The supernatant was gradiently diluted and the amount of *S. cerevisiae* detected using the proposed fluorescence method. For the counting method, the diluted microbial solution was placed on the sterile plate, mixed with Bengal red agar medium (cooled to 50℃), and cultivated at 28℃ for 1 day. The counting range was 30-300.

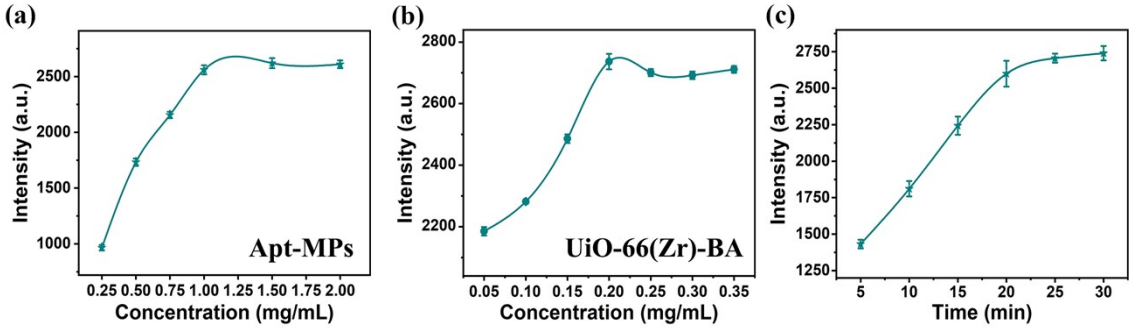

Fig. S1 Optimization of the assay. (a) Concentration of Apt-MPs; (b) concentration of UiO-66(Zr)-BA; (c) incubation time.

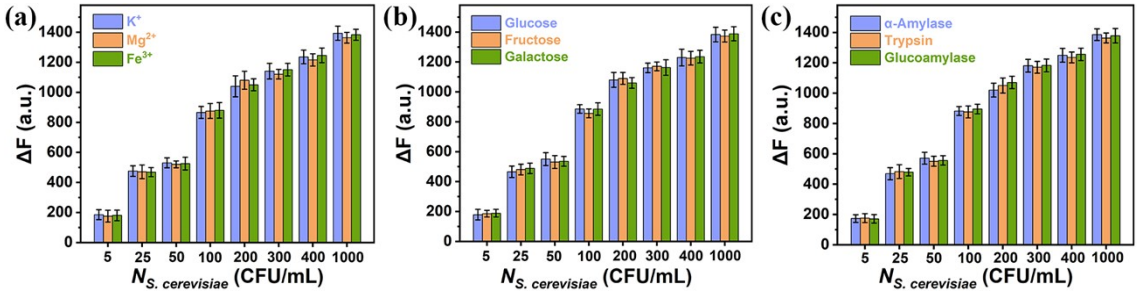

Fig. S2 Susceptibility fluorescence tests with different concentrations of *S. cerevisiae* and metal ions (K^+, Mg^{2+}, and Fe^{3+}, 100 mM) (a), small molecules (glucose, fructose, and galactose, 100 mM) (b), and proteins (α-amylase, trypsin, and glucoamylase, 5 mg/mL) (c).

Table S1 Comparison of the current approach to reported methods for *S. cerevisiae* analysis.

Detection method	Recognition component	Linear range (CFU/mL)	LOD (CFU/mL)	Test time (h)	Ref.
PCR	Specific primers	3.8-3.8×10^5	3.8	> 2	[1]
Optics	Silver sensitized by lectins	3.2×10^3-7×10^7	-	> 1.5	[2]
qPCR	Taqman	3.4×10^2-3.4×10^7	78	> 4	[3]
Cyclic voltammetry	TTCC/GCE	2×10^4-10^8	10^4	~ 1	[4]
Impedance spectroscopy	MPA(SAM)/AuE	10^2-10^8	10^2	~ 1	[5]
Fluorescence	Ionic liquid mediated carbon dots	5×10^2-1×10^6	5×10^2	~ 1.5	[6]
Fluorescence	Fluorescence	10-10^6	3	~ 0.5	This work

Table S2 The intra-batch and inter-batch precision of the proposed biosensor for *S. cerevisiae* detection.

S. cerevisiae	Intra-batch		Inter-batch	
(CFU/mL)	Mean ± SD	CV (%, n=6)	Mean ± SD	CV (%, n=6)
20	18 ± 1.0	5.6	22 ± 1.0	4.5
10^2	9.7×10 ± 5.9	6.1	1.1×10^2 ± 6.5	5.9
10^4	1.0×10^4 ± 3.3×10^2	3.3	9.9×10^3 ± 1.8×10^2	1.8
10^6	9.8×10^5 ±5.0×10^4	5.1	9.6×10^5 ±7.1×10^4	7.4

Table S3 Direct detection of *S. cerevisiae* in distilled yeasts.

	Proposed method		Counting method	
	Mean ($\times 10^3$ CFU/mL, n=5)	RSD (%)	Mean ($\times 10^3$CFU/mL, n=5)	RSD (%)
Distilled yeast 1	2.45	4.2	4.42	12
Distilled yeast 2	1.38	5.5	3.91	8.2
Distilled yeast 3	3.24	5.0	5.37	9.6

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