Electronic Supplementary Material (ESI) for Lab on a Chip.

A novel electromagnet-triggered pillar valve and its application in immunoassay on centrifugal platform

Supplementary materials

The electromagnet with an iron bar

Figure S1. The electromagnet used to trigger the ETP valve. It can control the movement of the iron bar on it.

Cy3-BSA	Cy3-BSA	Mouse-IgG	Mouse-IgG	Printing buffer	Printing buffer
Cy3-BSA	Cy3-BSA	Mouse-IgG	Mouse-IgG	Printing buffer	Printing buffer
T-2-BSA	T-2-BSA	T-2-BSA	AFB1-BSA	AFB1-BSA	AFB1-BSA
T-2-BSA	T-2-BSA	T-2-BSA	AFB1-BSA	AFB1-BSA	AFB1-BSA
OTA-BSA	OTA-BSA	OTA-BSA	ZEN-BSA	ZEN-BSA	ZEN-BSA
OTA-BSA	OTA-BSA	OTA-BSA	ZEN-BSA	ZEN-BSA	ZEN-BSA
Printing buffer	Printing buffer	Mouse-IgG	Mouse-IgG	Cy3-BSA	Cy3-BSA
Printing buffer	Printing buffer	Mouse-IgG	Mouse-IgG	Cy3-BSA	Cy3-BSA

Figure S2. Printing design of the microarray for immunoassay, consisted of the optimal concentration of each complete antigen and three controls (Cy3-BSA, blank, and mouse-IgG).

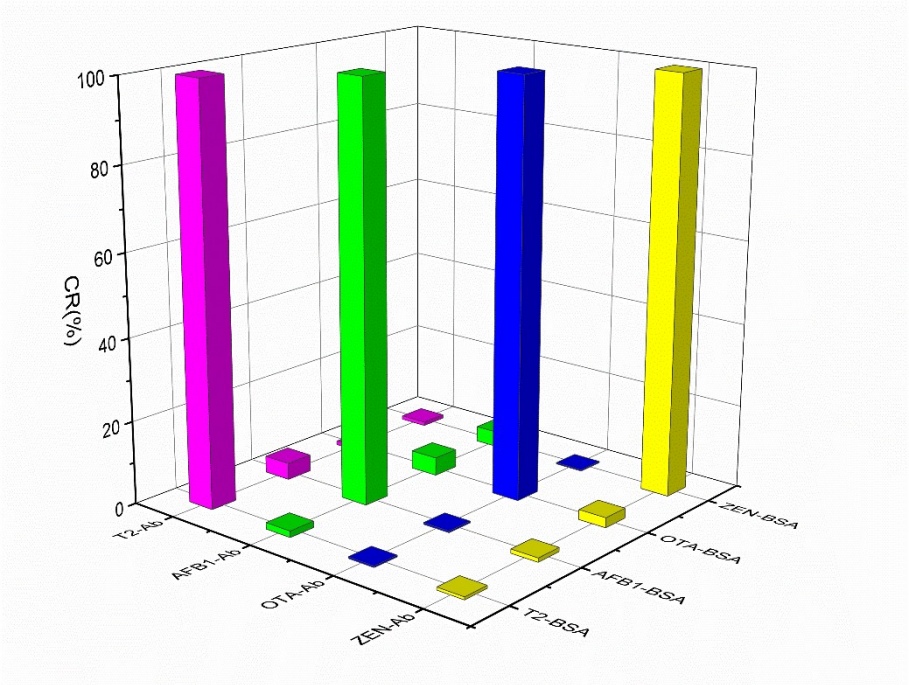

Figure S3. Cross-reactivities among the four antigens and antibodies.

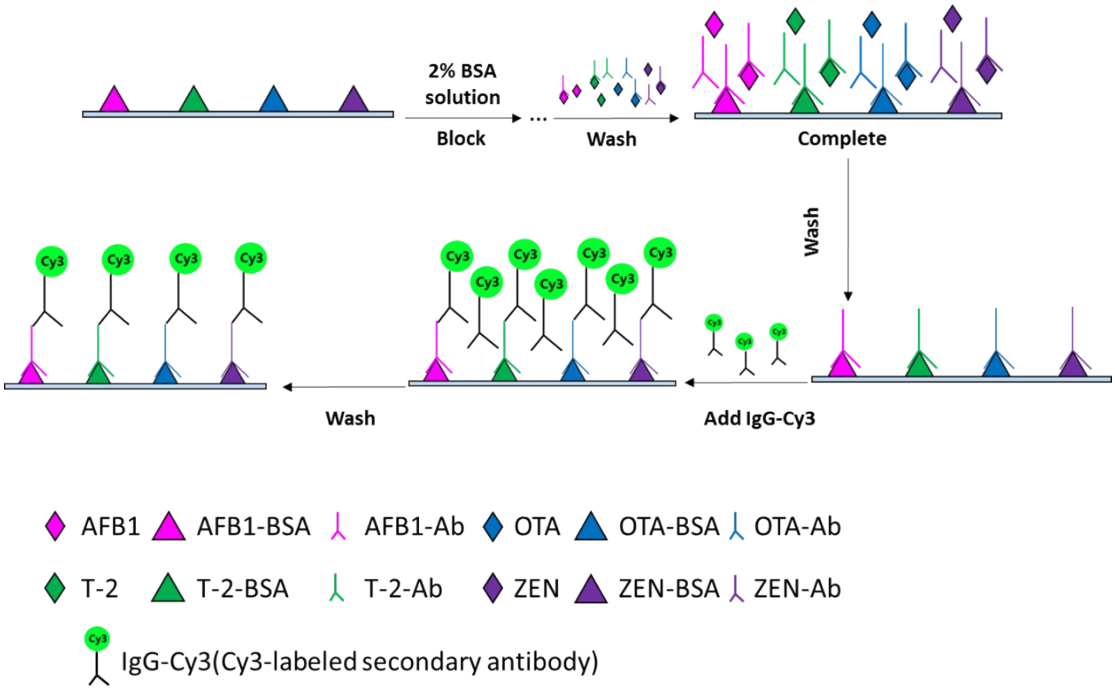

Figure S4. Schematic illustration of indirect competitive immunoassay for simultaneous and rapid detection of four mycotoxins.

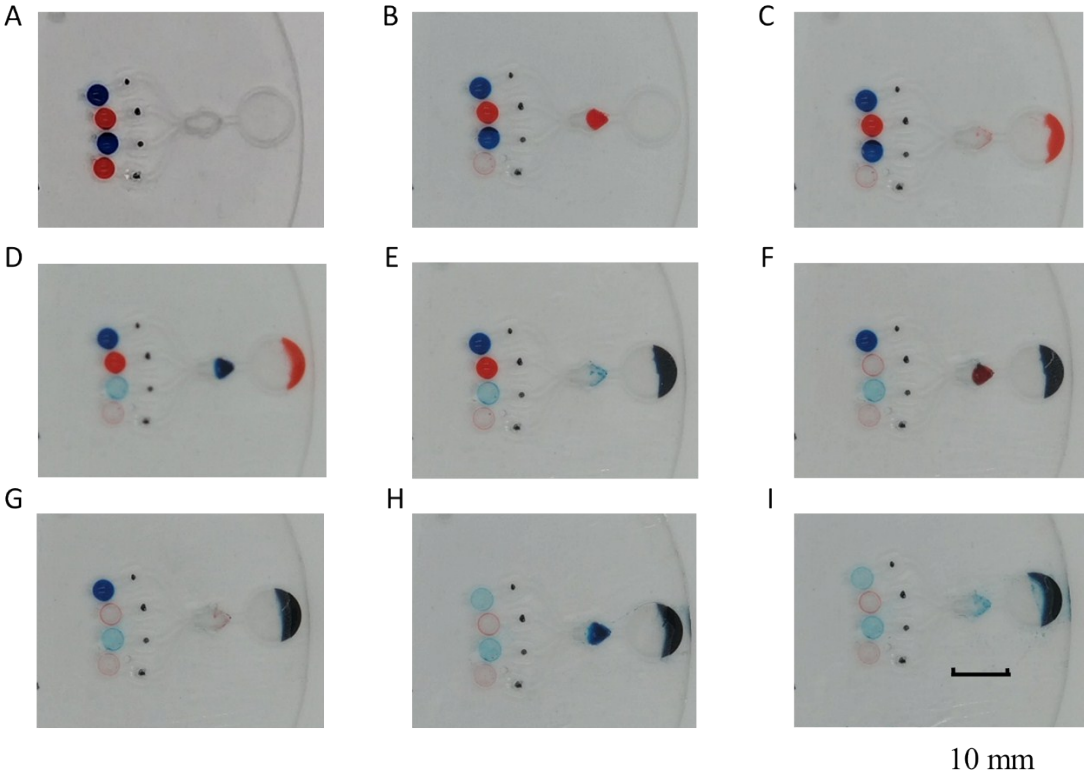

Figure S5. Work flow of the chip. The entire process is as follow: (A) The chip is fixed on the device. (B-C) The process of the first hybridization step. (D-E) The process of the first washing step. (F-G) The process of the second hybridization step. (H-I) The process of the second washing step. Each part consists of two steps: First, the sample, antibody solutions and washing buffer is centrifuged to the reaction chamber. Second, after the reaction or washing process, the liquid is centrifuged to the waste chamber.

Table S1. The values of force to open the EPT valves with different tapes. The forces were recorded by the counterweights that the valves can maintain or the electromagnet can lift.

Brand	Product number	Maximum tolerance force	Force of electromagnet
Adhesive Research (Glen Rock, PA)	90697	2.1 N	5 N
3M (St. Paul, MN)	9795R	1.9 N	
Youbisheng (Suzhou, China)	3715	2.4 N	

Table S2. Weight loss of pure water sealed on the chip.

Time (month)	Chip 1	Chip 2	Chip 3	Chip 4	Average
0	0	0	0	0	0
1	0.90%	0.96%	0.99%	1.03%	0.97% ± 0.05%
2	2.42%	2.46%	2.31%	2.60%	2.45% ± 0.12%
3	3.20%	3.14%	3.69%	3.04%	3.27% ± 0.29%

Table S3. Workflow of the immunoassay chip.

Step	Rotation speed	Time duration	Operation
1	0	10 s	Open the first ETP valve
2	800 rpm	20 min	The first hybridization
3	3000 rpm	10 s	Discard the waste to the waste chamber
4	0	10 s	Open the second ETP valve
5	800 rpm	20 min	The first washing step
6	3000 rpm	10 s	Discard the waste to the waste chamber
7	0	10 s	Open the third ETP valve
8	800 rpm	20 min	The second hybridization
9	3000 rpm	10 s	Discard the waste to the waste chamber
10	0	10 s	Open the fourth ETP valve
11	800 rpm	20 min	The second washing step
12	3000 rpm	10 s	Discard the waste to the waste chamber
13	0	10 s	Signal detection

Table S4. Standard ranges for the mycotoxins.

Mycotoxin	Concentration of five standards（ng/mL）				
	0	0.5×	1×	2×	4×
T-2	0	1	2	4	8
AFB1	0	1	2	4	8
OTA	0	4	8	16	32
ZEN	0	3	6	12	24