Supplementary Materials

A laser induced fluorescent detector for pesticide residues

detection based on spectral recognition method

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Fig. S1. Images of fluorescence difference spectra (Ki) of the sensing elements before and after the addition of various concentrations (0.01, 0.05, 0.2, 0.5 and 1ppm) of diazine. Inset: the linear plot of fluorescence intensity as a function of different concentrations. Error bars represented the standard deviations of three independent measurements.



Fig. S2. Images of fluorescence difference spectra (Ki) of the sensing elements before and after the addition of various concentrations (0.01, 0.05, 0.2, 0.5 and 1ppm) of fenvalerate. Inset: the linear plot of fluorescence intensity as a function of different concentrations. Error bars represented the standard deviations of three independent measurements.



Fig. S3. Images of fluorescence difference spectra (Ki) of the sensing elements before and after the addition of various concentrations (0.01, 0.05, 0.2, 0.5 and 1ppm) of pentachloronitrobenzene. Inset: the linear plot of fluorescence intensity as a function of different concentrations. Error bars represented the standard deviations of three independent measurements.

Fabrication of the MFSA

The main goal of this research was to design and fabricate a device for identification and discrimination of the four pesticide residues. For this purpose, the automation and integration of multilayer microfluidic platforms were fabricated. The structure of the microfluidic device is shown in Fig. 2(a), and the microfluidic chip can be considered to consist of 4 layers, as shown in Fig. 2(b). The glass disks where standard 110mm diameter 22mm plates having favorable optical properties without reflective coating serve as top and bottom layers. The 12 reactors design consist of 6mm diameter sample holes, layer (2), and 2mm deep chambers, which are connected with 1mm wide and 1mm deep channels with the vale interfaces to the chip center inlet. The middle layer (3) is 1.5mm thick polydimethylsiloxane (PDMS), used as an elastic membrane. The bottom layer is 1.5mm thick glass with 1mm deep air chambers in it. Thus, the middle layers, bonding with top and bottom layers, make up the pneumatic valves via carefully aligning and firmly pressing together. Definitely, the microfluidic device is assembled by 4 layers, which are integrated with the vent holes in the same position to pump interfaces.

Simulation of analytes concentration distribution in the MFSA

The flow velocity of the analytes in the microfluidic chip channel has a great influence on the concentration distribution. And the smooth concentration distribution plays an important role in ensuring the analytes spanking reaction. To assess the performance of the designed microfluidic chip for the reagents concentration distribution, the flow inside the chip channel was simulated through the finite element analysis software (Comsol Multiphysics 5.3a), which is commonly used to optimize parameters. In this simulation, the flow rate at the inlet is less than 2mm/s, and the Reynolds number, which is important for characterizing the flow, is

significantly less than 1. Thus, the creeping flow interface can be used. The convective term in the Navier-Stokes equations can be dropped, leaving the incompressible Stokes equations (Eq. (3)). Simultaneously, simulation was carried out by coupling the continuity equation (Eq. (4)), the mass balance equation (Eq. (5)) and Eq. (3).

$$\nabla \cdot (-\rho \mathbf{I} + \mu (\nabla u + (\nabla u)^T)) = 0$$
(3)
$$\nabla \cdot u = 0$$
(4)
$$-\nabla \cdot (-D\nabla c + cu) = 0$$
(5)

Whereµis viscosity, u is the velocity,pis the density, p is the pressure, ∇ is the divergence, D is the diffusion coefficient, and c is the concentration. The simulation results of pesticides concentration distribution under di erent flow velocities are shown in Fig. S4. It can be seen that clearly, with the flow velocity decreasing, the concentration distribution of pesticides is more and more uniform around the sensitive spot in the chamber and reaction equilibrium time is getting shorter and shorter. When the flow velocity reaches a certain value, the influence on the concentration distribution is not as obvious as it increase. In addition, the flow velocity should not be too slow, otherwise it is not conducive to the chemical reaction between pesticides and sensitive material. Eventually, comparing the various simulation results and actual measurement equilibrium time, the optimal parameter was chosen as the inset presented.



Fig. S4. Reaction equilibrium time for pesticides at 50ppb under different flow velocities (0.5, 1, 1.5, 2mm/s). Inset: Simulation prediction of the concentration distribution of pesticides in microfluidic channel under optimal flow velocities.

c.

Table S1

The resp	e response characteristics of four pesticides with different Ki. nd Ki Linear equation R ² Detection nimit (ppb) imit (ppb) nr. K1 Y=303.18+443.7X 0.990 8.29 K2 Y=-141.61-255.65X 0.997 6.33 K4 Y=-137.09-295.61X 0.994 4.55 K6 Y=177.18+278.35X 0.995 7.98 K9 Y=540.03+88.44X 0.965 9.15						
Kind	Ki	Linear equation	R ²	Detection			
				limit (ppb)			
Car.	K1	Y=303.18+443.7X	0.990	8.29			
	K2	Y=-141.61-255.65X	0.997	6.33			
	K4	Y=-137.09-295.61X	0.994	4.55			
	K6	Y=177.18+278.35X	0.995	7.98			
	K9	Y=540.03+88.44X	0.965	9.15			
Dia.	K2	Y=-200.75-123.21X	0.996	4.23			
	K3	Y=285.36+891.62X	0.983	6.87			
	K4	Y=-114.56-393.32X	0.993	6.56			
	K8	Y=85.58+263.99X	0.997	8.37			
	K12	Y=396.92+381.56X	0.984	5.49			
Fen.	K3	Y=363.81+532.44X	0.989	9.04			
	K4	Y=-194.54-408.13X	0.994	8.51			
	K5	Y=169.37+246.59X	0.982	8.26			
	K7	Y=285.36+891.62X	0.983	7.59			
	K8	Y=282.74+159.36X	0.996	5.68			
	K11	Y=-200.75-123.21	0.954	6.77			
	K12	Y=363.82+532.44X	0.988	3.89			
Pen.	K2	Y=-193.28-71.69X	0.967	4.93			
	K4	Y=-284.08-62.29X	0.983	5.60			
	K5	Y=253.77+313.72X	0.989	7.06			
	K6	Y=173.28+284.25X	0.995	7.89			

K10Y=106.90+160.72X0.9856.59K12Y=400.67+392.85X0.9965.30	K7	Y=400.67+392.85X	0.991	8.93
K12 Y=400.67+392.85X 0.996 5.30	K10	Y=106.90+160.72X	0.985	6.59
	K12	Y=400.67+392.85X	0.996	5.30