

## Supplemental file

### **Ultra-Sensitive Covalent Organic Frameworks based Smoldering Sensor for Early Warning of Granary Fire**

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## **Section S1. Instruments**

The instrument used in this FTIR experiment is a Nicolet iS50 Fourier transform infrared spectrometer from Seymour Fisher Technology Inc., USA.

Scanning electronic microscope (SEM) was operated on FEI Sirion 200 scanning electron microscope (JEOL Co., Ltd., Japan) with an operating voltage of 10 kV to observe the surface morphology of COFs, COFs coated filter paper and filter paper.

Nitrogen adsorption-desorption isotherms were measured on a Tristar II 3020 M automatic surface area and pore analyzer (Micromeritics Co., Ltd., USA) with a degassing temperature at 150°C. The Brunauer–Emmett–Teller (BET) method was utilized to calculate the specific surface areas of COFs.

X-ray photoelectron spectroscopy (XPS) was measured on ESCALAB QXin Electron Spectrometer from Seymour Fisher Technology Inc., USA

The GC/MS instrument model is Trace 1300 and ISQ QD produced by Seymour Fisher Technology Inc., USA. The sample transmission line temperature is set to 280 °C to avoid the condensation of pyrolysis gas and block the pipeline.

The data of the ultraviolet-visible spectrophotometer were measured on the 752 ultraviolet-visible spectrophotometer (Shanghai Jinghua Technology Instrument Co., Ltd., China.), and the experimental wavelength was 510 nm.

**Table S1** XPS elemental content of COFs and COFs/furfural/aniline hydrochloride.

Sample	C (at%)	O (at%)	N (at%)
COFs	61.9	3.4	26.27
COFs/furfural/aniline hydrochloride	70.83	2.9	34.7

**Table S2** Furfural coloration time

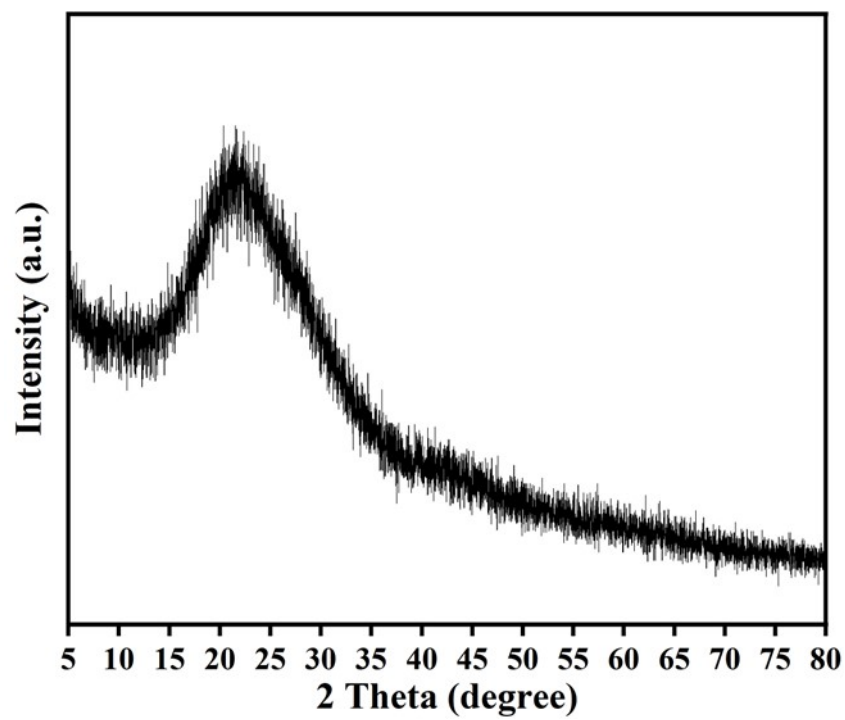
Group number	1	2	3	4	5	6	7
Furfural							
concentration	2	1	0.5	0.4	0.3	0.2	0.1
(ug/ml)							
coloration time							
(s)	13"56	15"54	20"54	53"08	1'27"45	1'41"57	19'35"42

**Table S3** RSS and filter paper of coloration time

Group number	1	2	3	4	5	6	7	88
Furfural concentration (ug/ml)	1	0.5	0.1	0.09	0.07	0.05	0.03	0.01
RSS coloration time (s)	10	13	78	99	156	363	1252	-
Filter paper coloration time (s)	30	136	389	427	1157	-	-	-

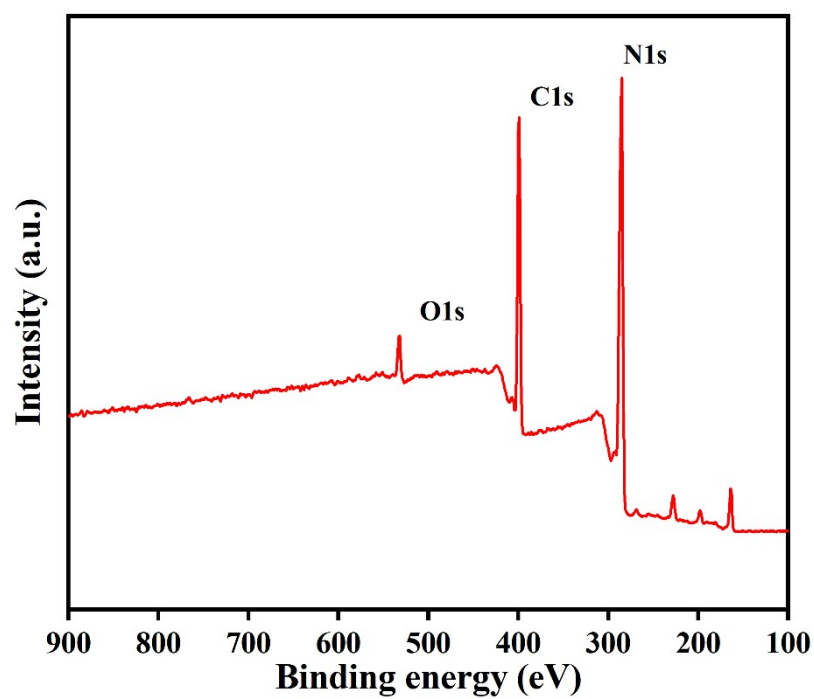
**Table S4** The RGB value and the corresponding thermocouple temperature data of the rice smoldering sensor under different heating time.

Heating time (min)	R	G	B	TC1 (°C )	TC2 (°C)	TC3 (°C)	depth of color
0	255	255	223	18	18	18	light
40	230	216	209	98	94.7	82.1	light
50	237	214	196	104.7	94.7	82.3	light
60	235	195	174	108.3	94.7	82.3	light
70	233	191	163	113.9	94.7	82.3	light
80	228	175	154	121.9	94.7	82.3	deep
90	216	160	154	130.1	94.7	82.3	deep
100	204	163	145	137.3	94.7	82.3	deep
110	212	140	140	143.1	94.7	82.3	deep
120	214	140	121	149.4	94.7	82.3	deep

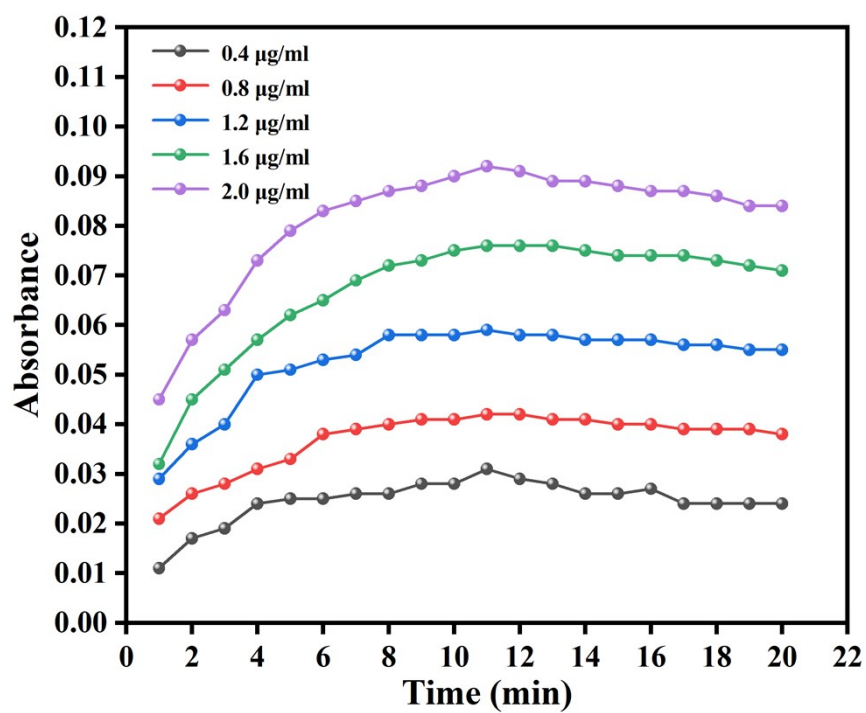


**Figure S1** XRD patterns of COFs.





**Figure S2** XPS survey spectra of COFs/furfural/aniline hydrochloride.



**Figure S3** Color absorbance curves of furfural with different concentrations.



Figure S4 The external physical map of rice before smoldering, uncarbonized (left);  
External physical map of rice after smoldering, carbonization (right).