Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.


# Supporting information

## A Dual-functional Intelligent Logic Detector Based on Ln-MOFs: First Visual Logical Probe for Two-dimensional Monitoring of Pyrethroid Biomarkers

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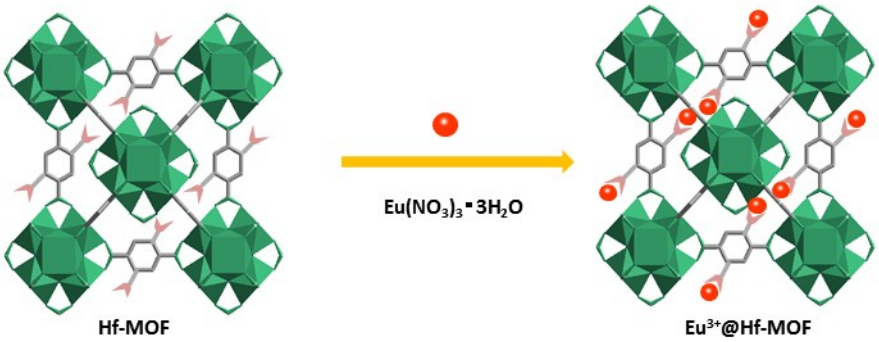


**Scheme S1** The structure of Hf-MOF and $Eu^{3+}$@Hf-MOF.

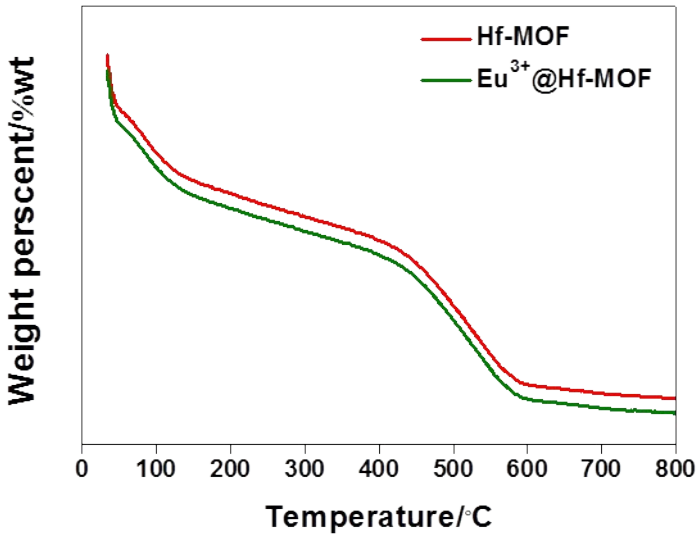


**Figure S1** Thermal gravimetric analysis (TGA) curves for Hf-MOF and $Eu^{3+}$@Hf-MOF.

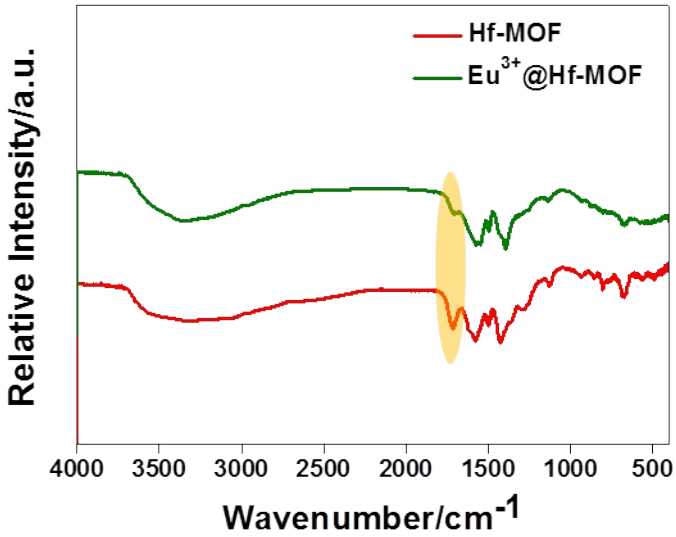


**Figure S2** FT-IR spectra of Hf-MOF and $Eu^{3+}$@Hf-MOF.

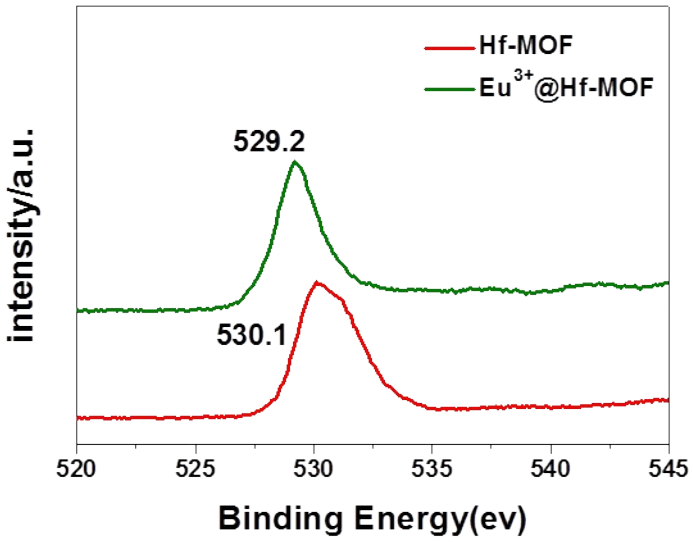


**Figure S3** The O 1S XPS spectra of Hf-MOF and $Eu^{3+}$@Hf-MOF.

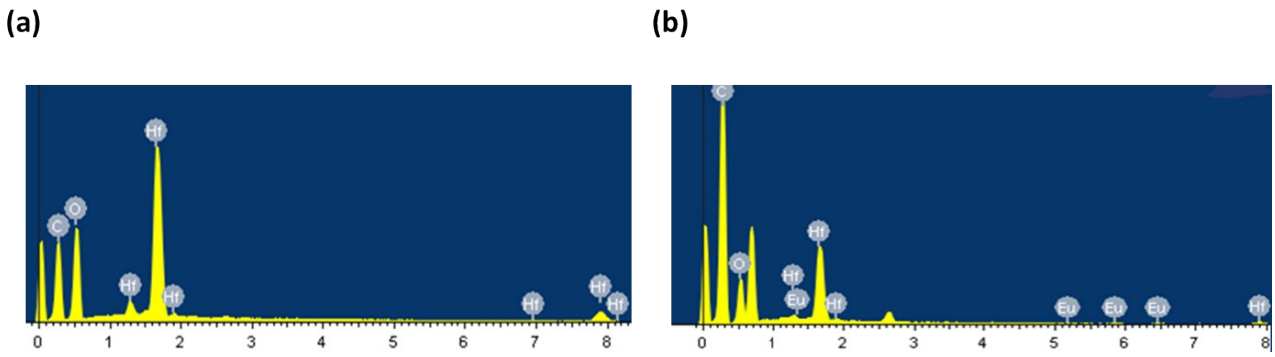


**Figure S4** The energy dispersive X-ray spectroscopy (EDX) of (a) Hf-MOF and (b) $Eu^{3+}$@Hf-MOF.

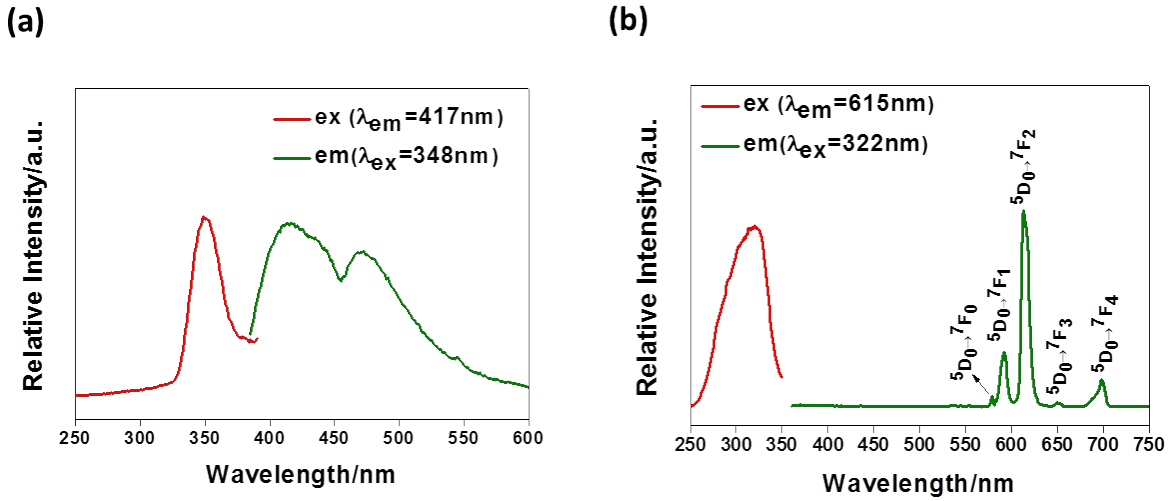


**Figure S5** The excitation (red line) and emission (green line) spectra of (a) Hf-MOF and (b) $Eu^{3+}$@Hf-MOF.

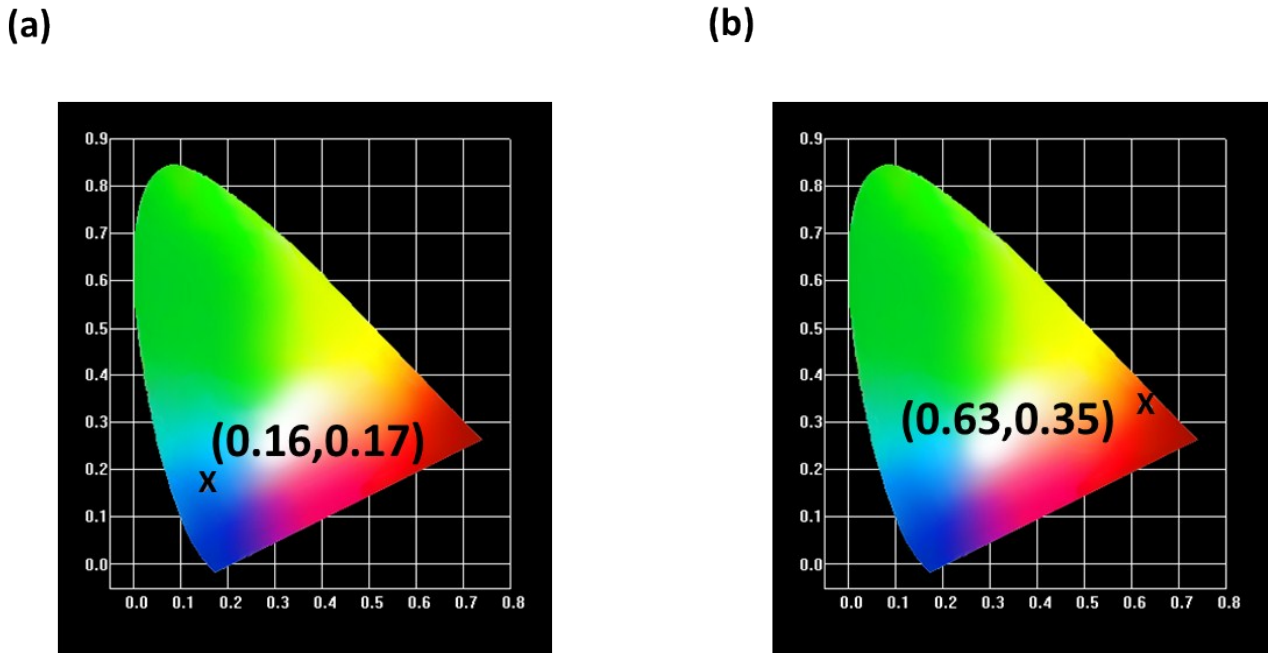


**Figure S6** The corresponding CIE chromaticity diagram of (a) Hf-MOF and (b) $Eu^{3+}$@Hf-MOF.

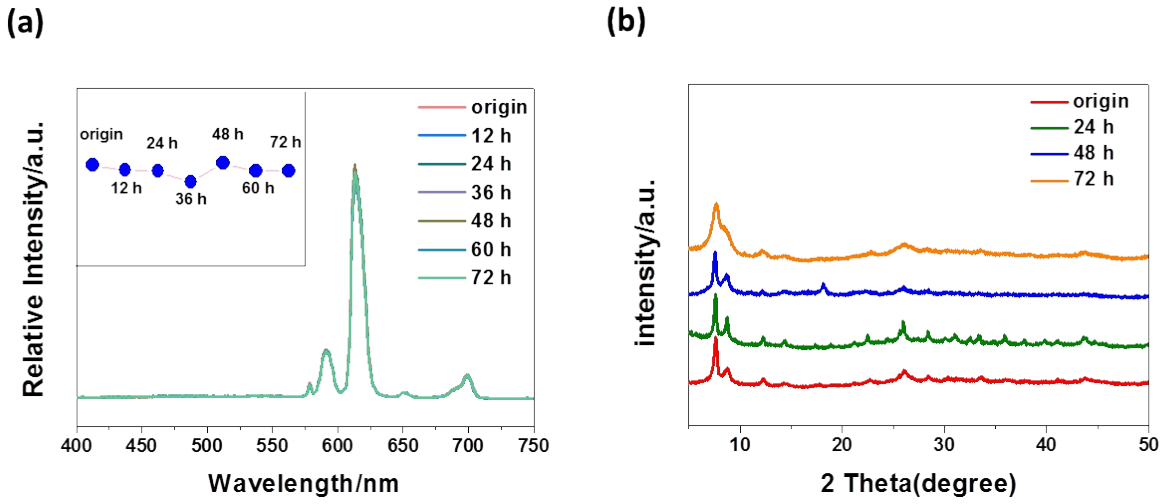


**Figure S7** (a) Hour to hour fluorescence stability of $Eu^{3+}$@Hf-MOF; (b) Hour to hour structure stability of $Eu^{3+}$@Hf-MOF.

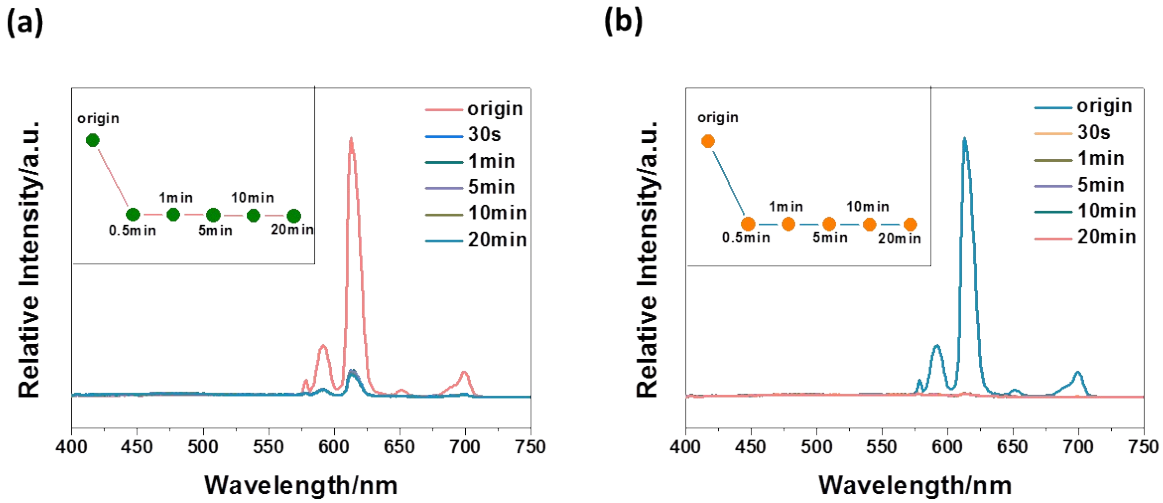


**Figure S8** Variation of luminescent intensity of $Eu^{3+}$@Hf-MOF with different immersion time in (a) 3-PBA and (b) 3-PBD.

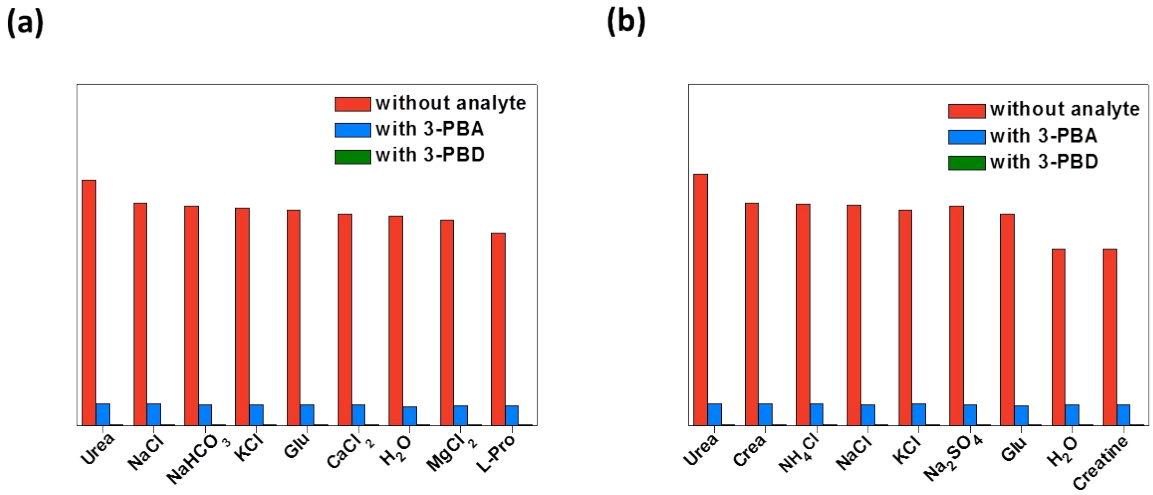


**Figure S9** Luminescence responses (red：without 3-PBA and 3-PBD; blue: with 3-PBA; green: with 3-PBD) of $Eu^{3+}$@Hf-MOF toward different solutions of (a) serum and (b) urine.

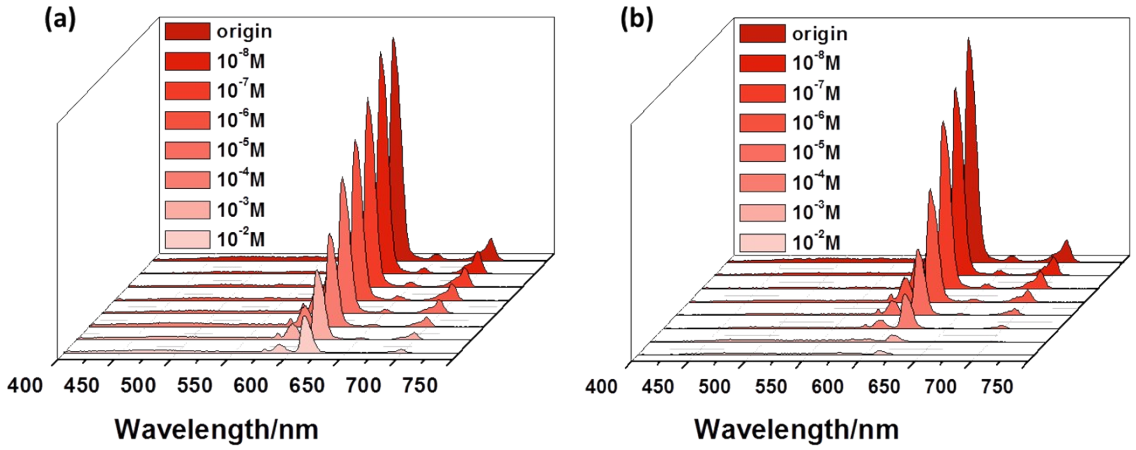


**Figure S10** Luminescence spectra of $Eu^{3+}$@Hf-MOF when immersing into different concentrations of (a) 3-PBA and (b) 3-PBD.

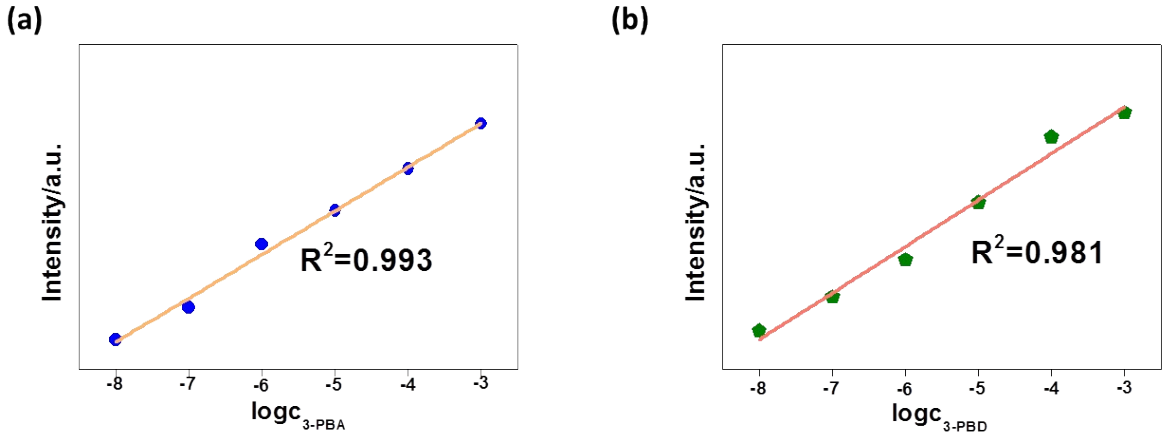


**Figure S11** Linear curve of the luminescent intensity of $Eu^{3+}$@Hf-MOF toward different concentrations of (a) 3-PBA and (b) 3-PBD.

**Table S1** The weight percentage and atomic percentage of all elements in $Eu^{3+}$@Hf-MOF determined by energy dispersive X-ray spectroscopy (EDX).

| Materials | Element | Weight% | Atomic% |
|---|---|---|---|
| $Eu^{3+}$@Hf-MOF | C | 59.54 | 77.54 |
| | O | 21.24 | 20.76 |
| | Hf | 18.10 | 1.59 |
| | Eu | 1.13 | 0.12 |

**Table S2** The ICP-MS studies of Hf-MOF and $Eu^{3+}$@Hf-MOF.

| Samples | Hf(ppm) | Eu(ppm) | Hf/Eu |
|---|---|---|---|
| Hf-MOF | 12.337 | / | / |
| $Eu^{3+}$@Hf-MOF | 13.542 | 1.845 | 7.340:1 |

**Table S3** Lifetimes of $Eu^{3+}$@Hf-MOF and $Eu^{3+}$@Hf-MOF immersed 3-PBA and 3-PBD when excited at 313nm and 322nm respectively.

| Lifetimes(μs) | $\lambda_{ex}$=313nm | $\lambda_{ex}$=322nm |
|---|---|---|
| Origin | 370.83μs | 361.26μs |
| 3-PBA | 325.75μs | 326.21μs |
| 3-PBD | 381.07μs | 349.68μs |

**Table S4** The truth table of Gate 1, Gate 2.

(a) Gate 1

| Input 1 | | Output 1 |
|---|---|---|
| $\lambda_{313nm}$ | $E_{(A/D)}$ | $\lambda_{614nm}$ |
| 1 | 0 | 1 |
| 1 | 1 | 0 |
| 0 | 0 | 0 |
| 0 | 1 | 0 |

(b) Gate 2

| Input 2 | | | Output 2 |
|---|---|---|---|
| $\lambda_{322nm}$ | $E_{(A)}$ | Output 1 | Light 2 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 |

**Table S5** The truth table of Gate 3, Gate 4 and Gate 5

(a) Gate 3

| Input 3 | | | Output 3 |
|---|---|---|---|
| $C_{3\text{-}PBA}<10^{-8}M$ | $\lambda_{313nm}$ | Output 2 | Light 1 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 |

(b) Gate 4

| Input 4 | | | Output 4 |
|---|---|---|---|
| $C_{3\text{-}PBA}<10^{-5}M$ | $\lambda_{313nm}$ | Output 3 | Light 2 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 |

(c) Gate 5

| Input 5 | | | Output 5 |
|---|---|---|---|
| $C_{3\text{-}PBA}<10^{-2}M$ | $\lambda_{313nm}$ | Output 4 | Light 3 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 |