**Supporting Information for**

# Three-component D-A hybrid heterostructures with enhanced photochromic, photomodulated luminescent and selectively anion-sensing properties

Meng-Hua Li [a], Shu-Li Lv [a], Ming-Hua You [b] and Mei-Jin Lin[a, c,d]*

[a] *State Key Laboratory of Photocatalysis on Energy and Environment, College of Chemistry, Fuzhou University, China, 350116. E-mail: meijin_lin@fzu.edu.cn.*

[b] *College of Zhicheng, Fuzhou University, China, 350002.*

[c] *College of Materials Science and Engineering, Fuzhou University, China, 350116*

[d] *Fujian Provincial Key Laboratory of Electrochemical Energy Storage Materials, Fuzhou University, Fuzhou, Fujian, 350002, China*

**Table of Contents:**

## 1. The additional crystal figure for 1-D channel and electron transfer

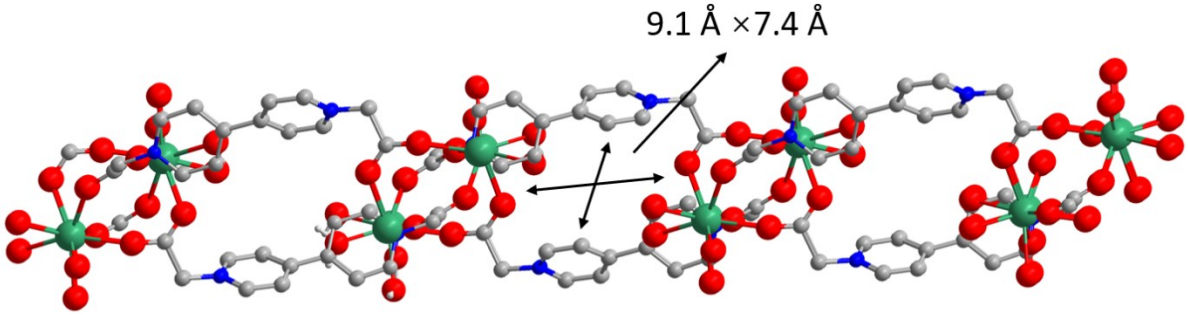


**Fig. S1.** The 1-D channels for hybrid **1** view along *b*-axis.

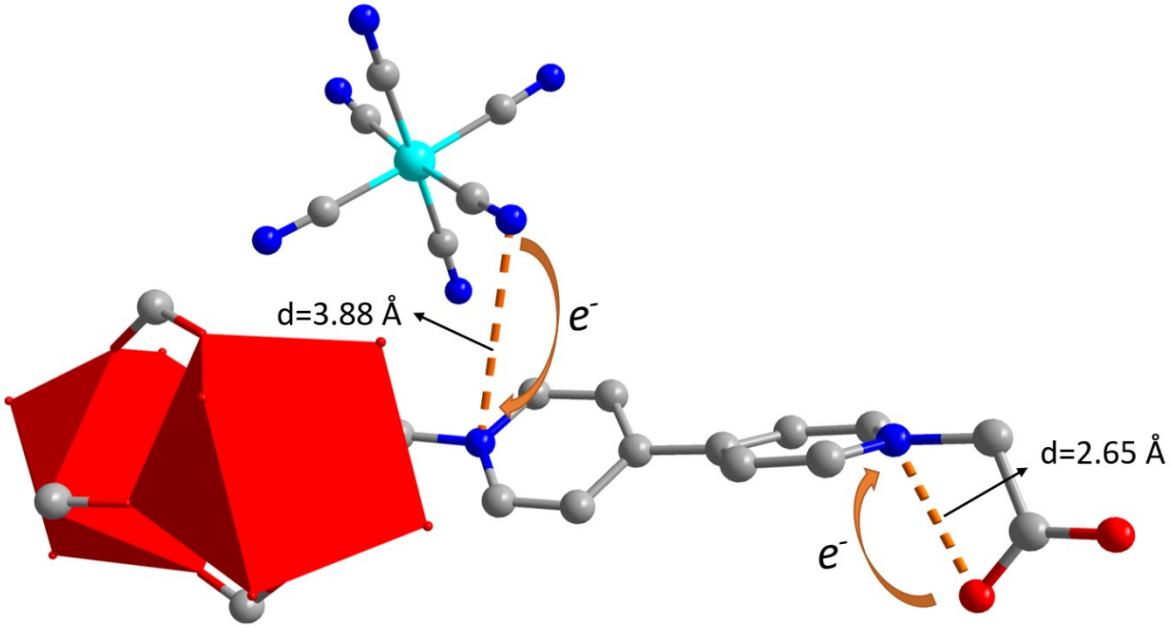


**Fig. S2.** The electron transfer orientation diagrams of $[Co(CN)_6]^{3-}$ and Bcebpy ligands in hybrid **1**.

## 2. Crystal data and structure refinement

Table S1: Crystal data and structure refinement for hybrids **1-3**.

| Identification code | **1** | **2** | **3** |
|---|---|---|---|
| Empirical formula | $C_{20}H_{26}CoEuN_8O_{11}$ | $C_{20}H_{22}CoDyN_8O_9$ | $C_{20}H_{24.5}CoN_8O_{10.5}Sm$ |
| Formula weight | 763.36 | 739.88 | 754.25 |
| Temperature/K | 293(2) | 293(2) | 296.15 |
| Crystal system | monoclinic | monoclinic | monoclinic |
| Space group | *C2/c* | *C2/c* | *C2/c* |
| a/Å | 31.279(4) | 31.279(5) | 31.267(2) |
| b/Å | 11.3928(6) | 11.3714(10) | 11.4024(6) |
| c/Å | 21.323(3) | 21.267(4) | 21.1252(14) |
| α/° | 90 | 90 | 90 |
| β/° | 130.59(2) | 130.46(3) | 130.659(2) |
| γ/° | 90 | 90 | 90 |
| Volume/Å$^3$ | 5770.4(18) | 5756(2) | 5713.4(6) |
| Z | 8 | 8 | 8 |
| $\rho_{calc}$ g/cm$^3$ | 1.757 | 1.708 | 1.754 |
| μ/mm$^{-1}$ | 2.796 | 3.211 | 2.682 |
| F(000) | 3024.0 | 2904.0 | 2988.0 |
| Reflections collected | 23184 | 22758 | 33182 |
| Independent reflections | 6562 | 5090 | 5042 |
| Data/restraints/parameters | 6562/0/387 | 5090/7/361 | 5042/2/395 |
| Goodness-of-fit on $F^2$ | 1.085 | 1.049 | 1.043 |
| Final R indexes [I>=2σ(I)] | $R_1$ = 0.0367, $wR_2$ = 0.0998 | $R_1$ = 0.0667, $wR_2$ = 0.1912 | $R_1$ = 0.0283, $wR_2$ = 0.0658 |
| Final R indexes [all data] | $R_1$ = 0.0554, $wR_2$ = 0.1118 | $R_1$ = 0.0918, $wR_2$ = 0.2527 | $R_1$ = 0.0329, $wR_2$ = 0.0692 |

## 3. Infrared spectral analysis

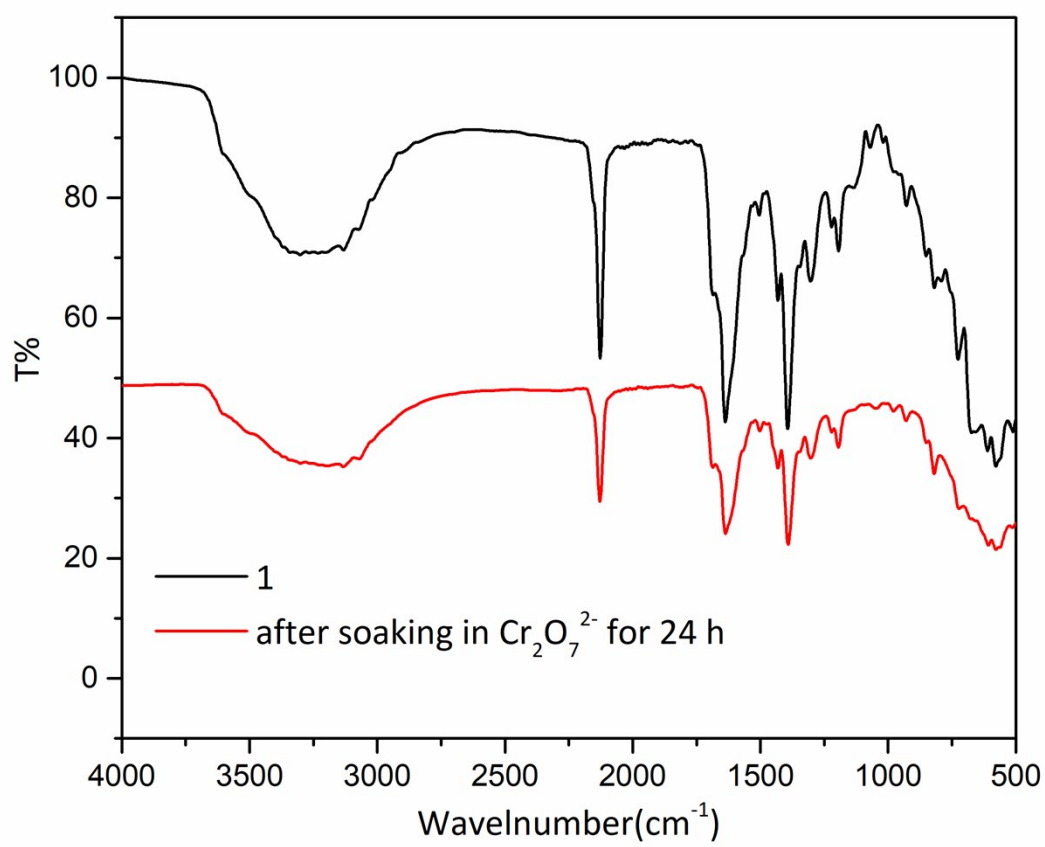


**Figure S3.** Infrared spectrum before and after soaking in $Cr_2O_7^{2-}$ for 24 h of **1**.

## 4. Thermo-gravimetric analysis (TG)

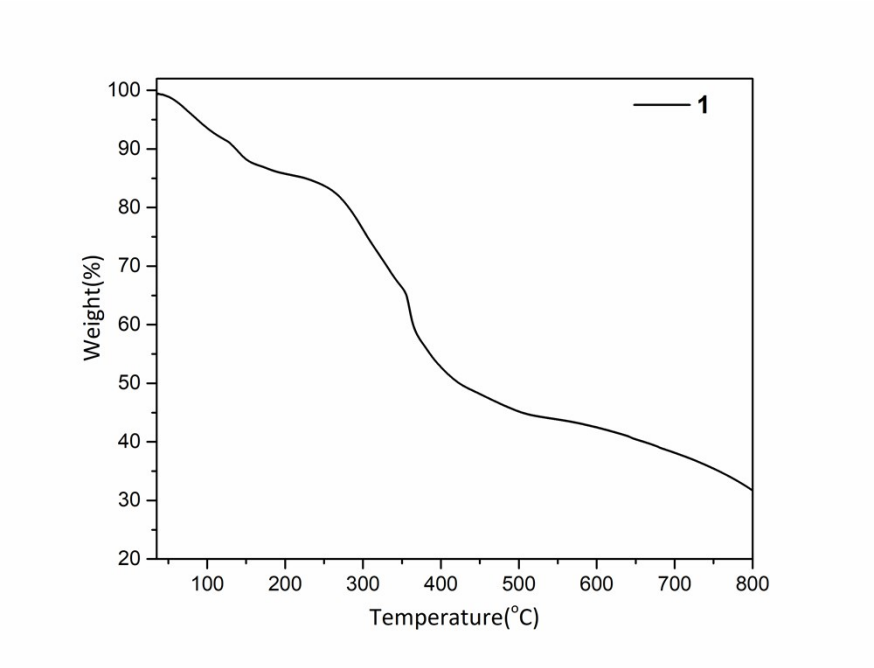


**Figure S4.** The TG curve of **1** under $N_2$ atmosphere with a heating rate of 10 °C/min.

## 5. X-ray powder diffraction analysis

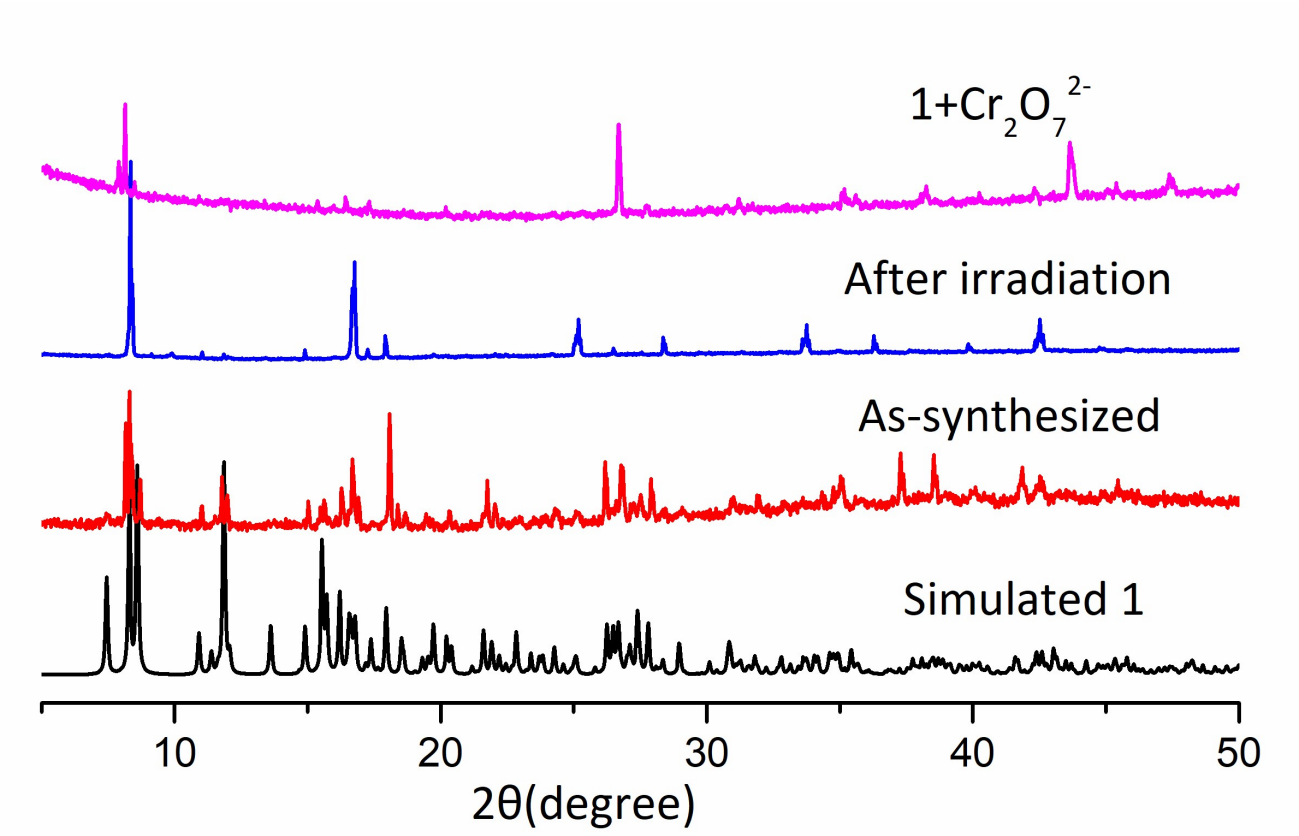


**Figure S5.** PXRD patterns of **1** after the irradiation and soaking in $Cr_2O_7^{2-}$ anion solution for 24 h.

## 6. Luminescence properties and sensing $Cr_2O_7^{2-}$

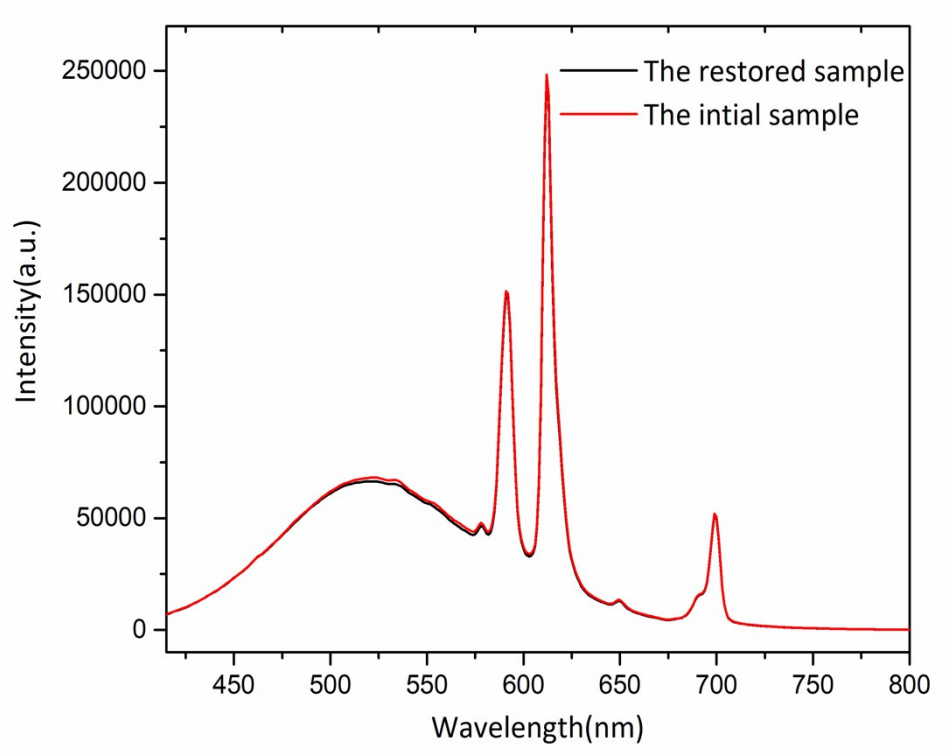


**Figure S6.** The luminescence emission of the original sample and the restored sample.

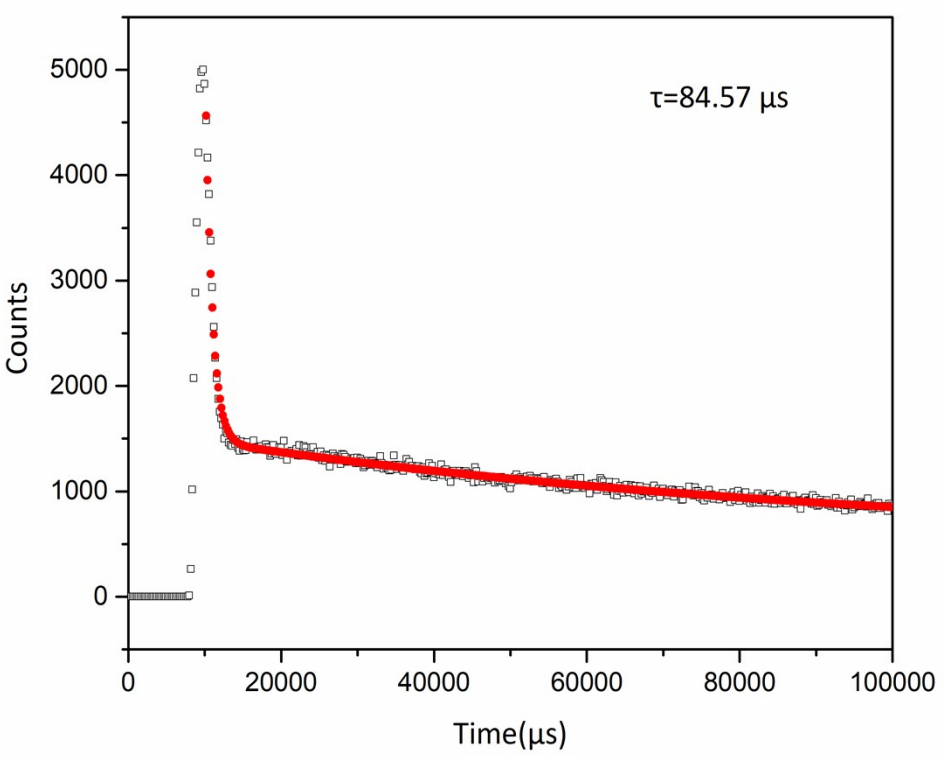


**Figure S7.** Luminescence decays of hybrids **1** under ambient conditions.

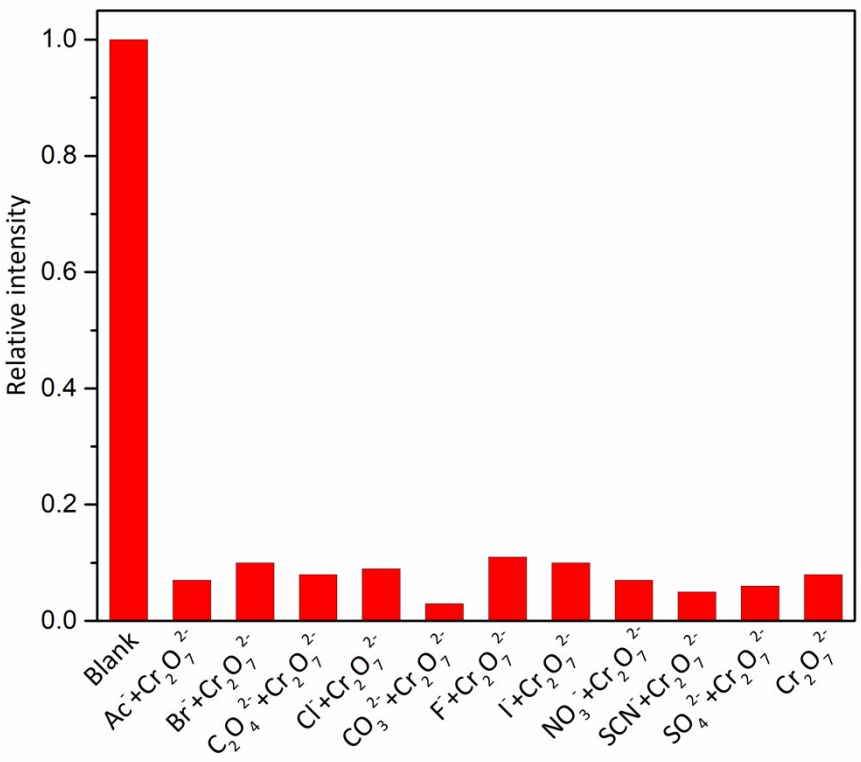


**Figure S8.** Comparison of the relative luminescence intensity of $Cr_2O_7^{2-}$ in the presence of mixed anions for **1**.

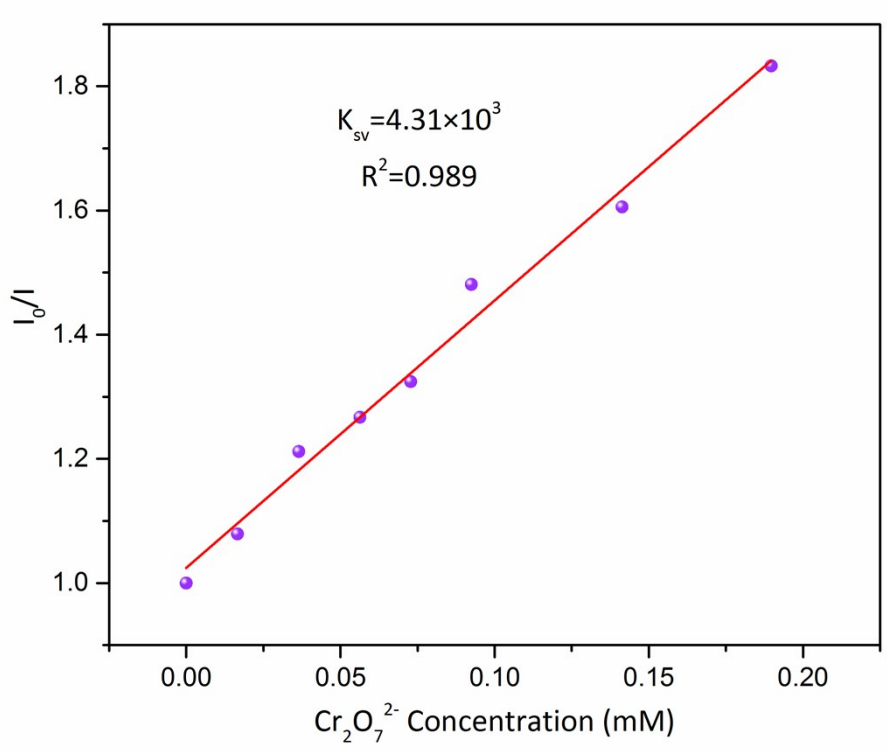


**Figure S9.** The Stern-Volmer plot of quenched by $Cr_2O_7^{2-}$ in $CH_3OH$. The red line corresponds to a linear fitting result.

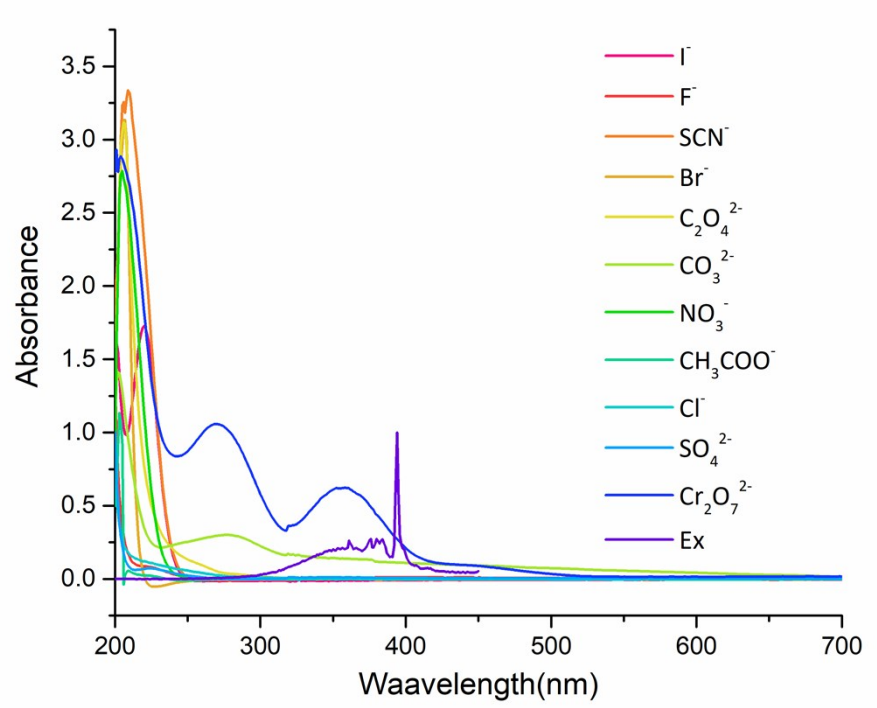


**Fig S10.** The UV-vis absorption spectra of anions and the excitation spectrum of **1**.

## 7. XPS for compound 1

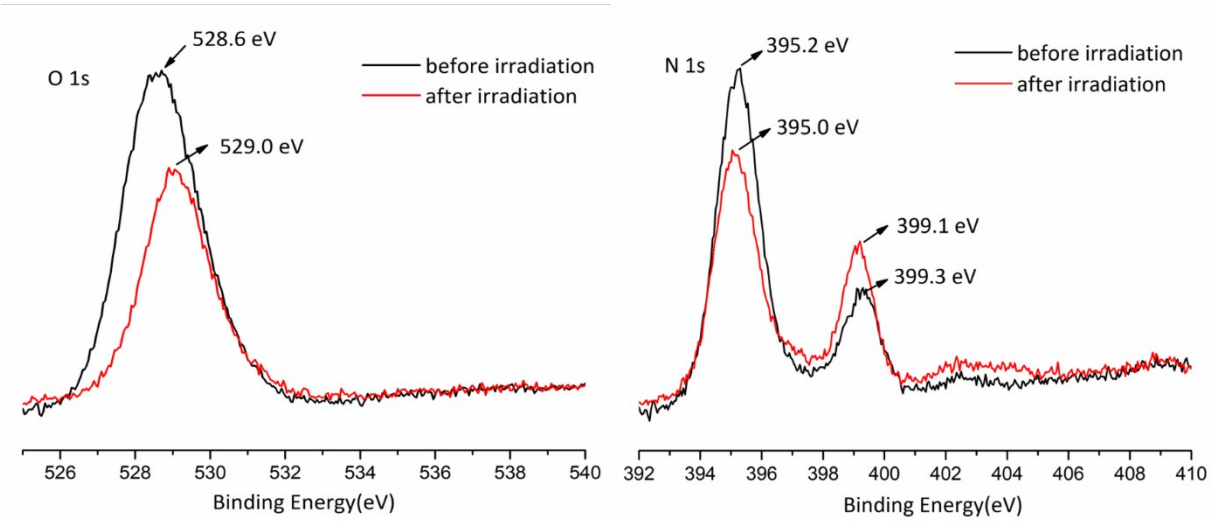


**Fig. S11** XPS core level spectra of O and N atoms in hybrid **1**.

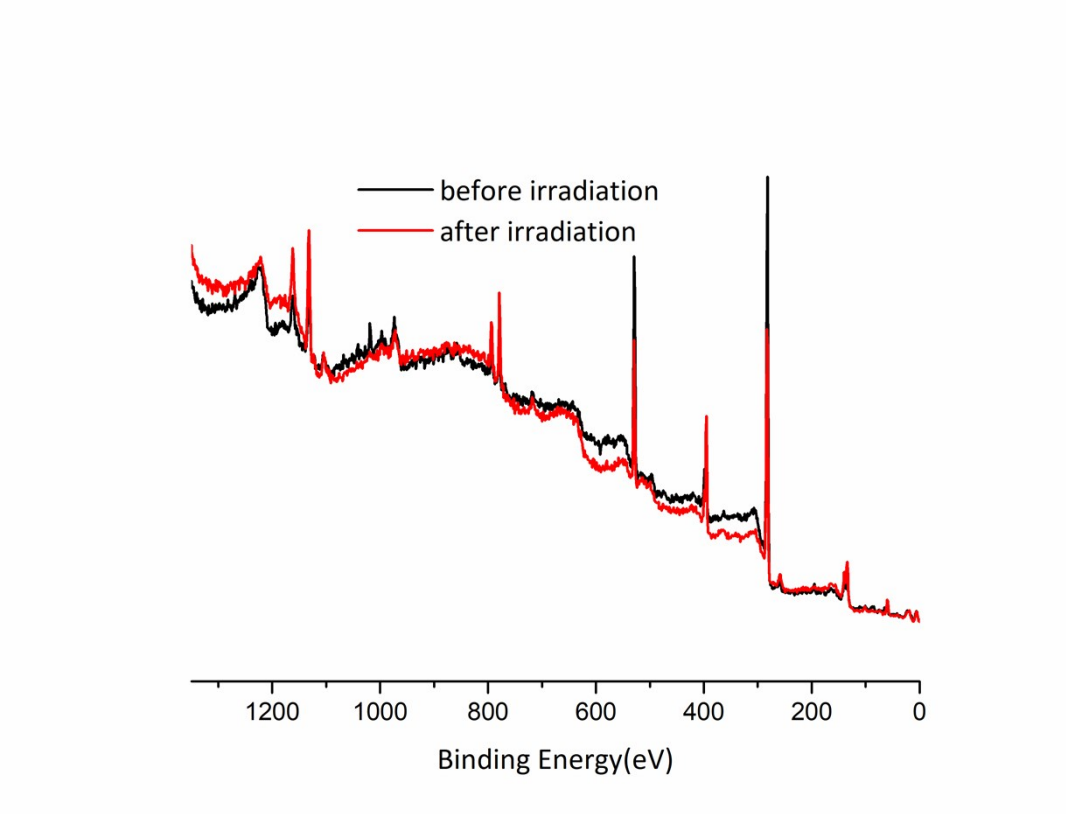


**Fig. S12** XPS of hybrid **1**.

## 8. EDS analysis of hybrid 1

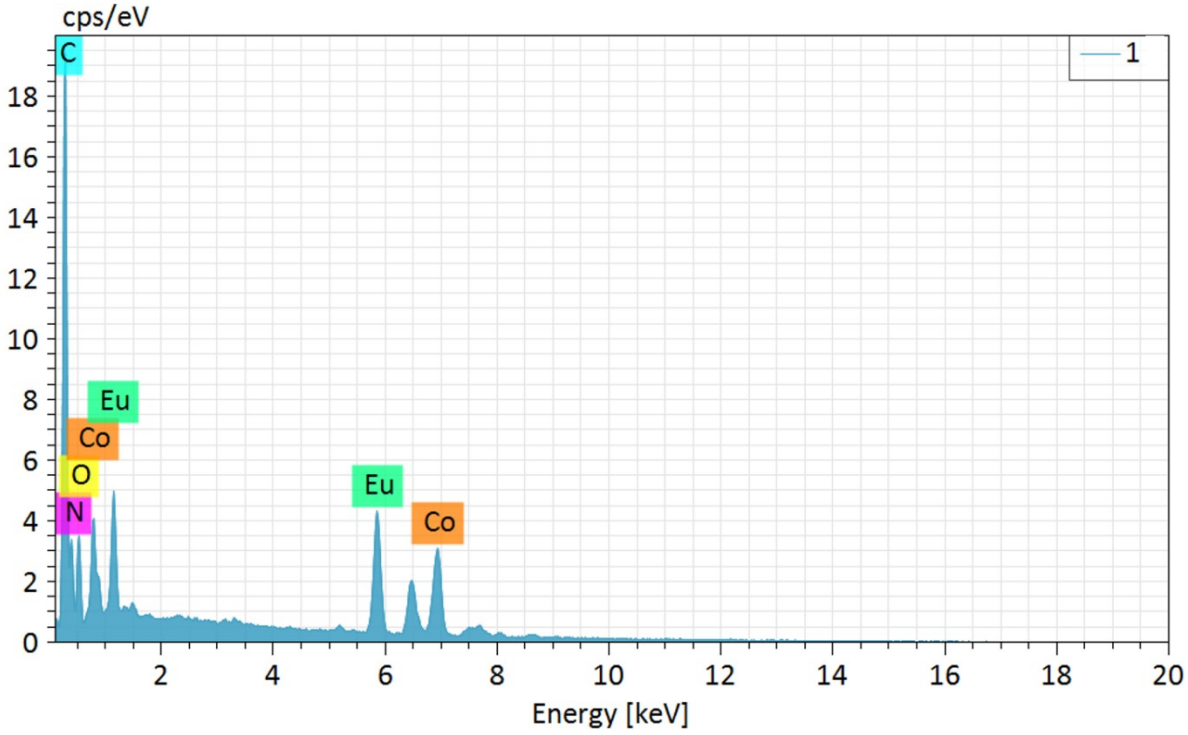


**Fig. S13** EDX analysis of hybrid **1**.