Surporting Information for the manuscript

Synthesis and Crystal Structure of Copper(II) Complex of Curcumin-type and Application for in Vivo Early Tumor Imaging

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Part 1 Structure Characterizitions of the compounds

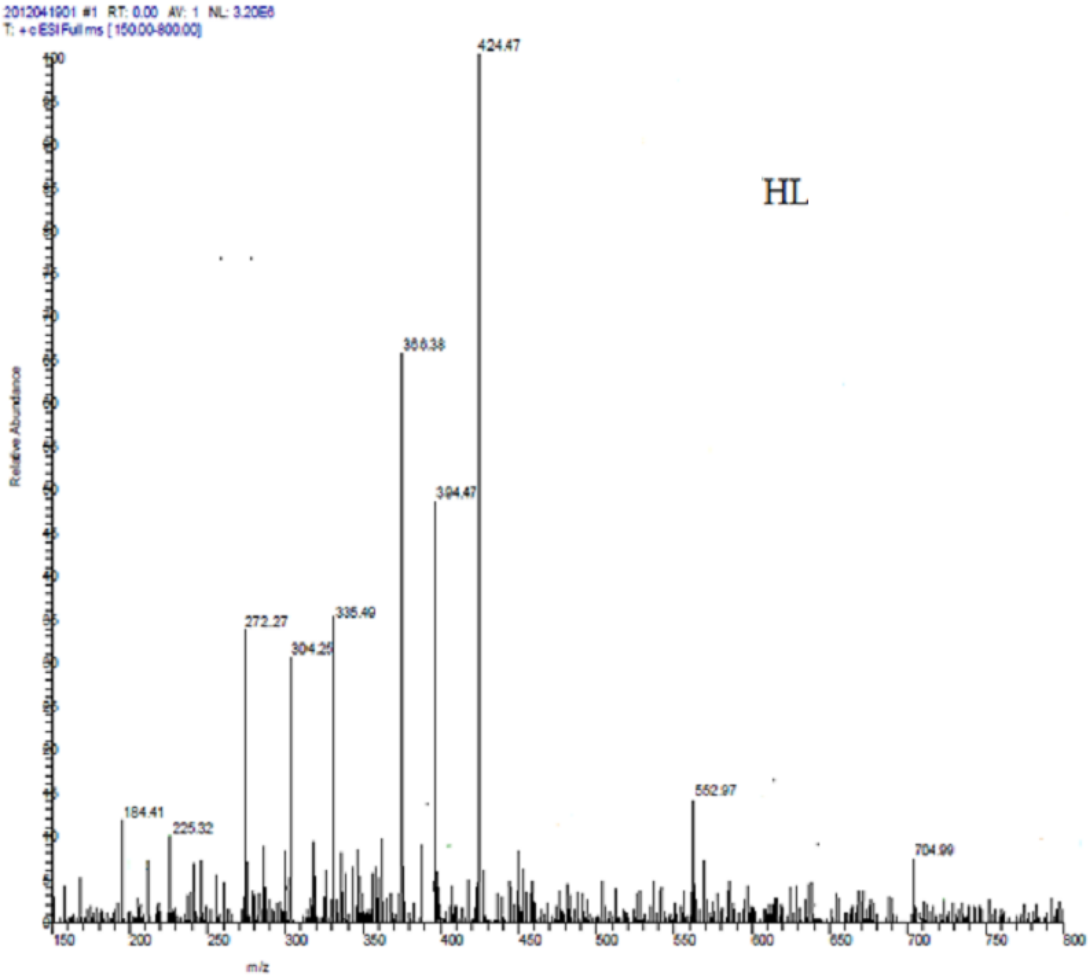

Fig.S1. MS specta of HL

Crystal Structure Determinations: The molecular structures of HL and $CuL_2 \cdot C_4H_8O_2$ were shown in Fig. S2-S3. The unit cell, data collection and refinement parameters are located in the following Table S1，Tables S2 and S3 shows selected bond lengths and angles of HL and $CuL_2 \cdot C_4H_8O_2$.

1. Crystal Structure of **HL**:

In the molecular structure of **HL**, the least-square plane calculation shows that the dihedral angle between the two benzene rings is 8.2, indicating that they are nearly coplanar. The sum of the three C-C-C bond angles is 359.9º, which take carbon atom(C5) as center (C6-C5-C7, 118.7(3)º; C6-C5-C4, 118.5(3)º; C4-C5-C7, 122.7(3)º). This result demonstrates that the carbon atom (C7) is practically coplanar with the benzene ring. Furthermore,it can be seen from Table 2 that all the bond lengths of C-C are located between the normal C=C double bond (1.32 Å) and C–C single bond (1.53 Å), which demonstrates that it is a π-electron highly delocalized system for **HL**.

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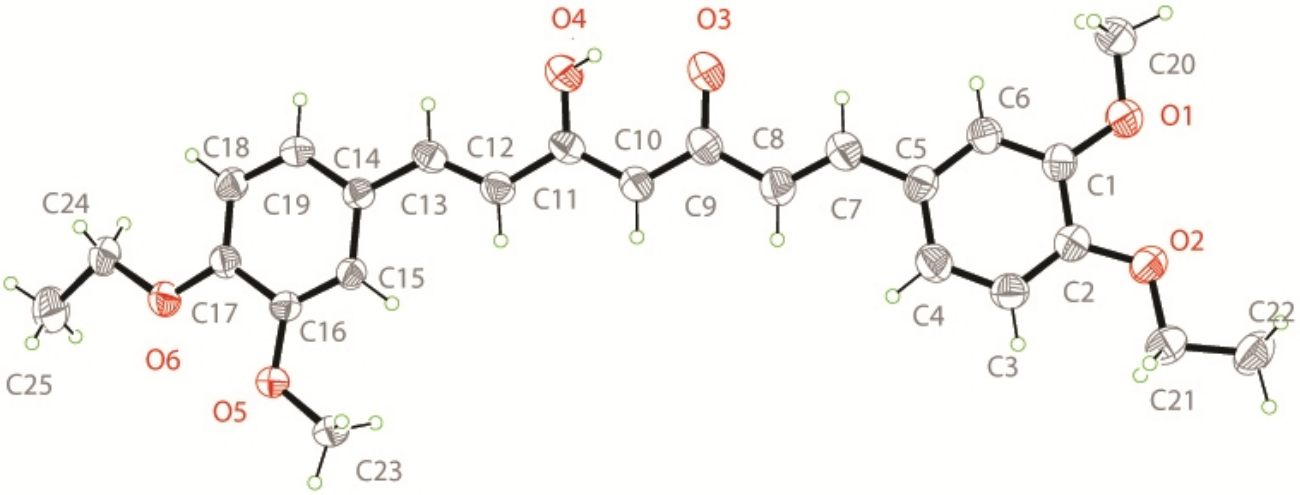
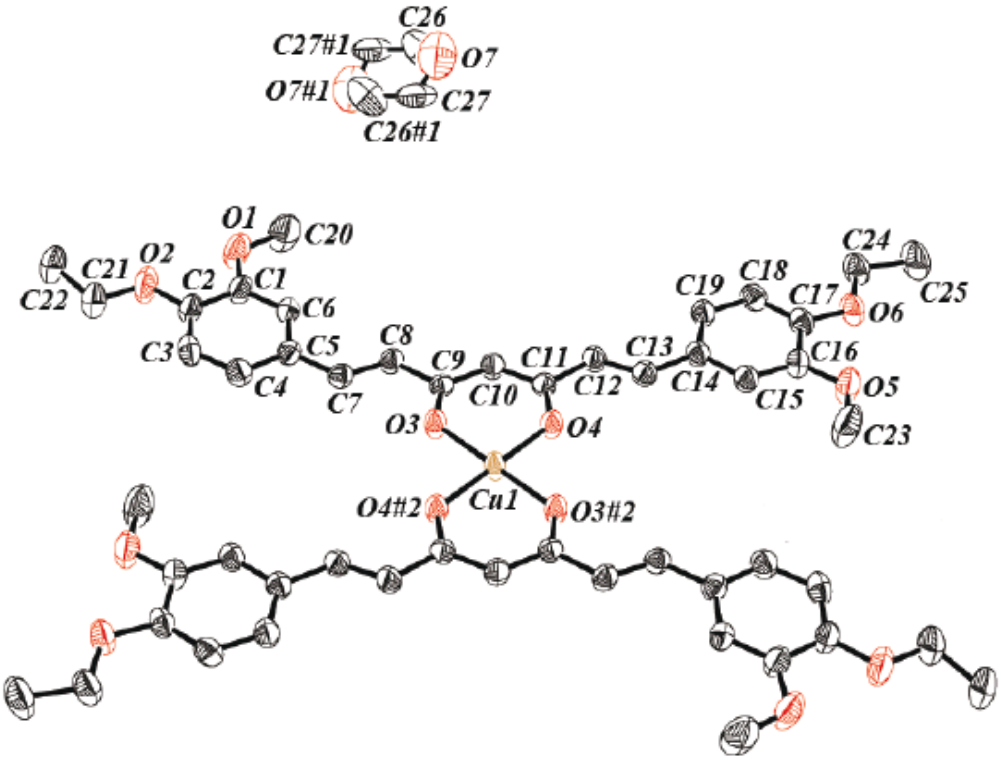


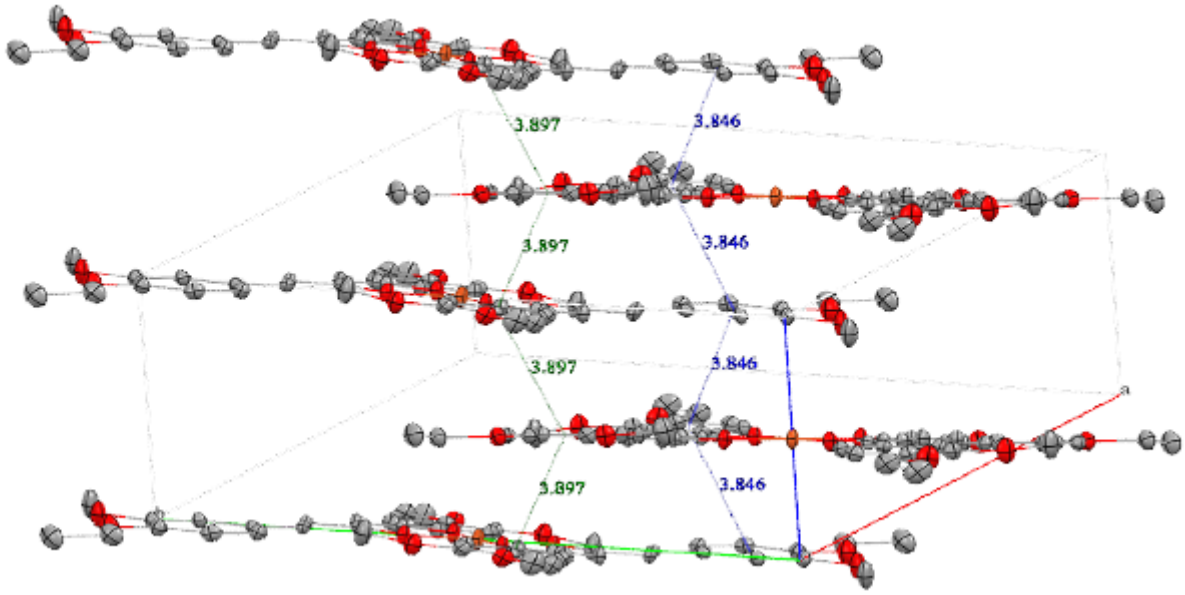
Fig. S2. The ORTEP structure of **HL** (50% thermal ellipsoid probability)

2. Crystal Structure of $\mathbf{CuL_2 \cdot C_4H_8O_2}$: In Figure S3b, an infinite 1D columnar arrangement along c-axis has been found, which was stabilized by the two π-π interactions with the short distances of 3.897 and 3.846 Å to form the 1D structure. The 1D columns are linked each other through the same π-π stacking interactions to form a 3D framework(Figure S3c).

a


C26
C27#1
O7
O7#1
C27
C26#1
O1
C20
C21
O2
C22
C2
C1
C6
C3
C5
C8
C9
C11
C13
C4
C7
C10
C12
C14
C15
O3
O4
Cu1
O4#2
O3#2
C19
C18
C17
C24
C25
O6
C16
O5
C23

b


3.897
3.846
3.897
3.846
3.897
3.846
3.897
3.846

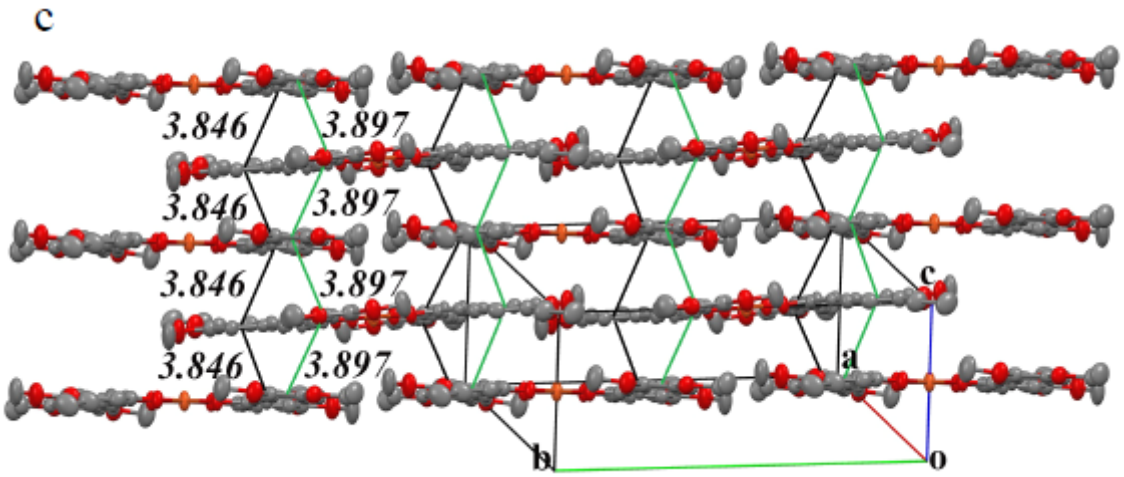


Fig. S3. (a) ORTEP structure of Cu(II) complex with atomic labeling scheme (with 50% thermal ellipsoid probability), all hydrogen atoms are omitted for clarity. (b) View showing the 1D columnar arrangement stabilized by π-π interactions. (c) View showing the 3D supramolecular structure of the Cu(II) Complex.

Table S1. Crystal data and structure refinement parameters for **HL** and **$CuL_2 \cdot C_4H_8O_2$**

Entry	HL	$CuL_2 \cdot C_4H_8O_2$
CCDC	896630	991272
Formula	$C_{25}H_{28}O_6$	$C_{54}H_{62}CuO_{14}$
Weight	424.47	998.58
T[K]	298(2)	296(2)
λ(Mo-Kα)[Å]	0.71069	0.71069
Crystal system	Monoclinic	Monoclinic
Spaceg group	P2(1)/n	P2(1)/c
a[Å]	22.689(5)	21.86(2)
b[Å]	4.913(5)	16.453(16)
c[Å]	23.224(5)	7.184(7)
β[°]	115.744(5)	97.643(11)
Volume[$Å^3$]	2332(2)	2561(4)
Z	4	2
D(calc)[g/cm^3]	1.209	1.295
μ[mm^{-1}]	0.086	0.492
F(000)	904	1054
Range(º)	1.05-25.00	0.94-25.00
Index range	-26≦h≦26 -5≦k≦5 -27≦l≦27	-25≦h≦25 -18≦k≦19 -8≦l≦8
Reflections/unique	15081/4099	17861/4510
R(int)	0.0461	0.0247
Data/restraints/ parameters	40996 / 0 / 285	4510/ 0 / 317
Final R indices [I>2σ(I)] R indices (all data)	R1 = 0.0484, wR2 = 0.1134 R1 = 0.1144, wR2 = 0.1582	R1 = 0.0503, wR2 = 0.1420 R1 = 0.0629 wR2 = 0.1557
GOF on F^2	0.993	1.095
Completeness to theta = 25.00	100%	99.9%

Table S2. Selected bond lengths [Å] and angles [º] for **HL**

Bond Length	
C5－C7	1.471(4)
C7－C8	1.320(4)
C8－C9	1.475(4)
O3－C9	1.304(4)
C9－C10	1.386(4)
C10－C11	1.404(4)
O4－C11	1.301(3)
C11－C12	1.449(4)
C12－C13	1.338(4)
C13－C14	1.457(4)
Bond Angle	
C6－C5－C4	118.5(3)
C6－C5－C7	118.7(3)
C4－C5－C7	122.7(3)
C19－C14－C15	117.6(2)
C19－C14－C13	120.0(2)
C15－C14－C13	122.3(2)

Table S3. Selected bond lengths [Å] and angles [º] for $CuL_2 \cdot C_4H_8O_2$

Bond Length	
Cu1 O3	1.9031(18)
Cu1 O4	1.9282(18)
O3 C9	1.283(3)
O4 C11	1.278(3)
C5 C7	1.465(3)
C7 C8	1.337(4)
C9 C8	1.474(3)
C10 C9	1.402(4)
C11 C10	1.410(3)
C11 C12	1.474(3)
C12 C13	1.337(3)
C14 C13	1.468(3)
Bond Angle	
O3 Cu1 O4	93.57(8)
C11 O4 Cu1	126.15(16)
C9 O3 Cu1	126.89(16)
C4 C5 C6	117.8(2)
C4 C5 C7	123.6(2)
C6 C5 C7	118.6(2)
O4 C11 C10	124.2(2)
O4 C11 C12	117.0(2)
O3 C9 C10	124.1(2)
O3 C9 C8	115.9(2)
C10 C9 C8	120.0(2)
C9 C10 C11	125.0(3)
C15 C14 C13	122.4(2)
C19 C14 C13	119.8(3)
C19 C14 C15	117.8(2)

Part 3

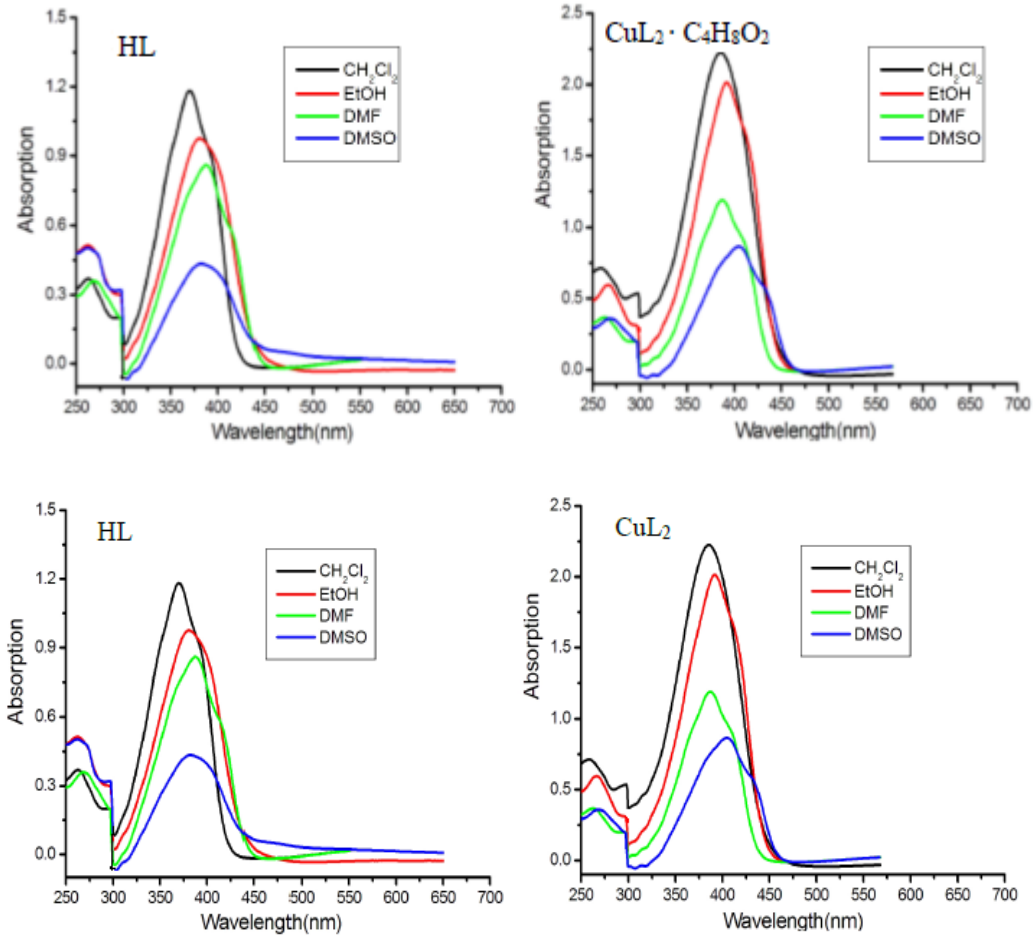
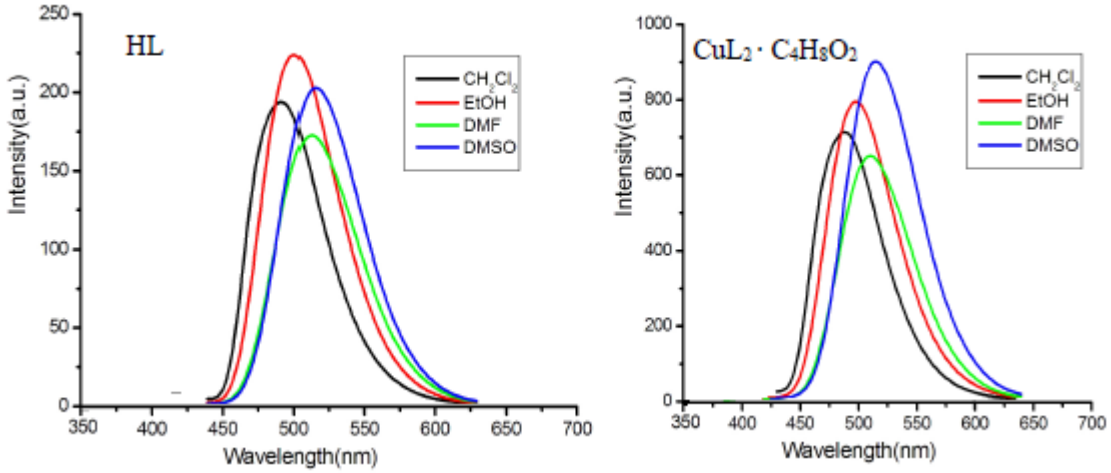


Figure S4. Linear absorption spectra of HL and CuL_2 in several solvents with differing Polarity



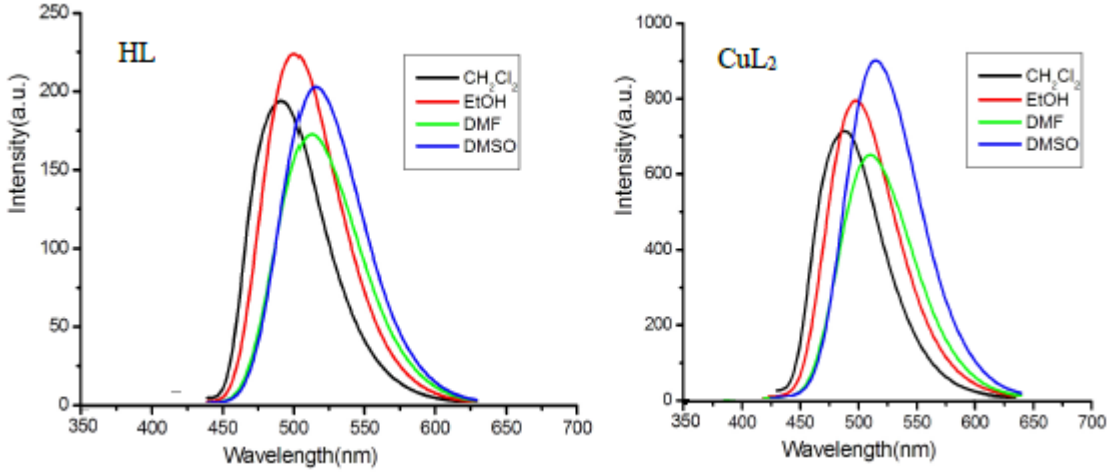


Figure S5. SPEF spectra of of HL and CuL_2 in several solvents with differing Polarity.

TPA cross-section σ:

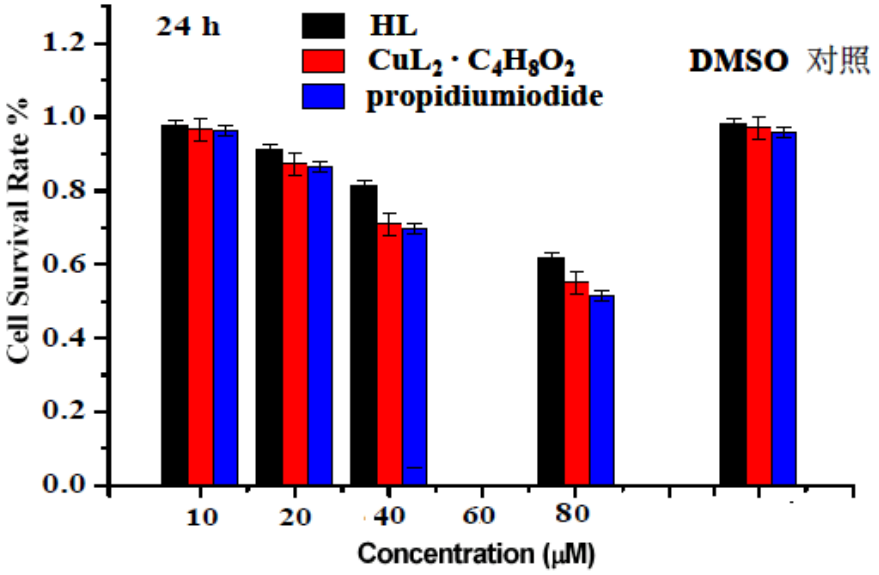
The TPA cross-section σ was measured by comparing the TPEF intensity of the sample with that of a reference compound by the following Equations S1 and S2:

$$\Phi_S = \Phi_r \left(\frac{A_r(\lambda_r)}{A_s(\lambda_s)} \right) \left(\frac{I(\lambda_r)}{I(\lambda_s)} \right) \left(\frac{n_s^2}{n_r^2} \right) \frac{\int F_s}{\int F_r} \quad \text{(S1)}$$

$$\sigma s = \sigma_r F \Phi_r c_r n_r / F_r \Phi s \, c \, n_s \quad \text{(S2)}$$

Here, n is the refractive index, I(λ) is the relative intensity of the exciting light, A(λ) is the absorbance of the solution at the exciting wavelength λ, Φ is the quantum yield, c is the concentration of the solution in mol/L and F is the integrated area under the corrected emission spectrum, subscripts s and r denote the sample and reference solutions, respectively. The σ_r value of reference was taken from t the RhB ethanol solution($\Phi_r = 0.69$, $c = 1\times 10^{-6}$ mol/ L). The experimental errors are estimated to be ±10% from sample concentrations and instruments.

Cytotoxicity assay:



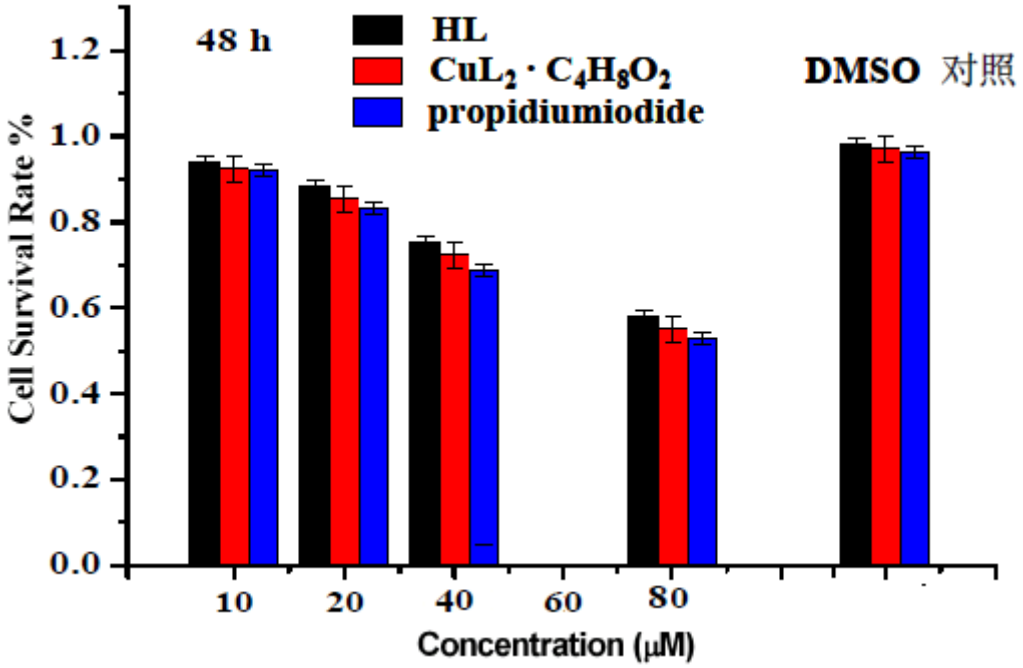


Figure S6. cytotoxicity data results of obtained compounds against MCF-7 cell line(24 h) from the MTT assay.