Electronic Supplementary Material (ESI) for Green Chemistry.

Furan-2-carbaldehydes as C1 building blocks for the synthesis of quinazolin-4(3*H*)-ones via ligand-free photocatalytic C-C bond cleavage

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Supporting Information

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1. General Information

Unless otherwise indicated, all reagents were purchased from commercial sources and used without further purification, and all experiments were conducted in air. Photoredox reactions were performed using a high-pressure mercury lamp or metal halide lamp (both from Shanghai Jiguang Tezhong Zhaoming Co.) as the light source. Organic solutions were concentrated

under reduced pressure in a rotary evaporator (Beijing Ruichengweiye Co.) in a water bath. Chromatographic purification of compounds was carried out using forced-flow chromatography on silica gel (Qingdao Haiyanghuagong Co., 200–300 mesh). Thin-layer chromatography (TLC) was performed on Silicycle 0.25-mm silica gel F-254 plates (TLC Silica gel 60 F254, 25 Aluminum sheets, 20 cm × 20 cm). ^{1}H and ^{13}C NMR spectra were recorded at 298 K using a JEOL ECA-400 spectrometer. ^{1}H NMR (400 MHz) chemical shifts are reported relative to TMS (δ = 0.00 ppm) or residual $CDCl_3$ (7.26 ppm) as an internal standard. ^{1}H NMR data are reported as follows: chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, dd = doublet of doublets, dt = doublet of triplets, and br = broad), coupling constant (Hz), and integration. ^{13}C NMR data are reported in terms of chemical shift relative to $CDCl_3$ (77.16 ppm) or DMSO (40.00 ppm). IR spectra were recorded on a ReactIR^{TM}15 spectrometer (Mettler Toledo) and are reported in wavenumbers (cm^{-1}). High-resolution mass spectra were recorded on an Agilent 1260 system using the ESI technique. HPLC analysis was performed on a Shimadzu system equipped with an SPD-15 C detector. UV-Vis absorbance spectra were recorded on an Agilent CARY-100 system using two 4.5-mm quartz cuvettes. The EPR spectra were recorded on an ELEXSYS-II E500 spectrophotometer (Bruker).

2. General HPLC procedure

HPLC analysis was performed using an Agilent TC-C18 column (150 mm × 4.6 mm, 5 μm) and a detector (SPD-15C) at 254 nm. An acetonitrile/water mixture ($V_{acetonitrile}$:V_{water} = 45:55 or 50:50) was used as the mobile phase, which was filtered through a 0.45 μm filter membrane followed by ultrasonic degassing for 20 min. The sample injection volume was 20 μL, and the flow rate was 1 mL/min.

2.1 Reaction condition optimization

The reaction solutions (0.5 mL) were separated and evaporated to remove the solvent. To the resulting residues, a mobile phase (2 mL, $V_{acetonitrile}$:V_{water} = 50:50) was added, and then the system was well mixed by ultrasonic treatment. The obtained solutions were filtered before injection into the HPLC system (Fig. S7). The yields of **3** were determined using the area normalization method (Table 1).

2.2 Reaction kinetics of furan-2-carbaldehydes

2,5-Diphenyl-1,3,4-oxadiazole (100 mg) was dissolved in ethanol (100 mL) to prepare the internal standard solution (1.0 mg/mL). Aliquots of the reaction solutions (0.5 mL) were taken at 0, 1, 2, 3, 4, 5, and 6 h, and the internal standard solution (0.5 mL) was added. The resulting mixtures were evaporated by a rotary evaporator to remove the solvent. To the residues, the mobile phase (2 mL, $V_{acetonitrile}$:V_{water} = 50:50) was added and well mixed by ultrasonic treatment. The obtained solutions were filtered before injection into the HPLC system (Fig. 2). The yields were determined based on the internal standard.

2.3 Reaction kinetics under different light sources

2-Nitroanisole (10 mg) was dissolved in the mobile phase (50 mL, $V_{acetonitrile}$:V_{water} = 45:55) to prepare the internal standard solution (0.2 mg/mL). Aliquots of the reaction solutions (0.5 mL) were taken at 0, 0.5, 1, 2, 3, and 4 h, and evaporated by a rotary evaporator to remove the solvent. The internal standard solution (2 mL) was added to the resulting residues. The obtained solutions were well mixed by ultrasonic treatment, and filtered before injection into the HPLC system (Fig. 4).

2.4 Kinetic study of two possible reaction pathways

2-Nitroanisole (100 mg) was dissolved in ethanol (100 mL) to prepare the internal standard solution (1.0 mg/mL). Aliquots of the reaction solutions (0.5 mL) were taken at 0, 0.5, 1, 2, 3, and 4.5 h, and the internal standard solution (0.5 mL) was added. The resulting mixtures were evaporated by a rotary evaporator to remove the solvent. To the resulting residues, the mobile phase (2 mL, $V_{acetonitrile}$:V_{water} = 45:55) was added and well mixed by ultrasonic treatment. The obtained solutions were filtered before injection into the HPLC system (Fig. 7).

3. UV-Vis absorbance studies

Compound **2** (30.4 mg) was dissolved in ethanol (25 mL), and the resulting solution was diluted to obtain solution **A** (2×10^{-5} mmol/mL). $CuCl_2$ (13.4 mg) was dissolved in ethanol (25 mL) and further diluted to obtain solution **B** (2×10^{-5} mmol/mL). Compound **2** (30.4 mg) and $CuCl_2$ (13.4 mg) were dissolved in ethanol (25 mL), and the resulting solution was diluted to obtain solution **C** (Cu: 2×10^{-5} mmol/mL, compound **2**: 2×10^{-5} mmol/mL). Baseline correction was performed using two cuvettes (0.45 cm) filled with ethanol (3 mL). The UV-Vis absorption spectra of solutions **A**, **B**, and **C** were recorded from 200 to 400 nm (Fig. 5).

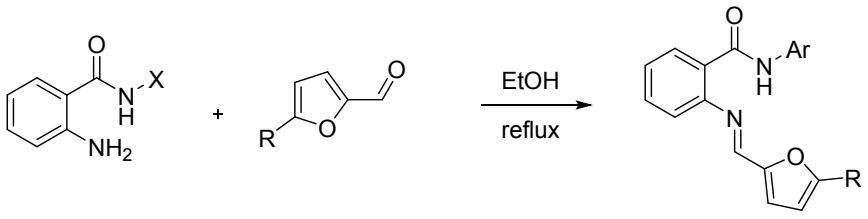
4. IR studies of the reaction complexes

The IR spectra were recorded on a ReactIR™ 15 spectrometer (Mettler Toledo) according to the manual. Acetone (5 mL) was placed in a reaction bottle, and its IR spectrum was recorded as background. Compound **2** (374 mg) was dissolved in acetone (5 mL) to obtain solution **D**, $CuCl_2$ (72 mg) was dissolved in acetone (5 mL) to obtain solution **E**, and compound **2** (375 mg) and $CuCl_2$ (108 mg) were dissolved in acetone (5 mL) to obtain solution **F**. The IR spectra of compound **2**, $CuCl_2$, and compound **2** + $CuCl_2$ were obtained by subtracting the background data from the IR data of solutions **D**, **E**, and **F**, respectively (Fig. S3).

5. EPR studies of the reaction complexes

Compound **2** (30.4 mg) was dissolved in ethanol (25 mL) to obtain solution **G**, compound **2** (30.4 mg) and $CuCl_2$ (2.7 mg) were dissolved in ethanol (25 mL) to obtain solution **H**, and $CuCl_2$ (2.7 mg) was dissolved in ethanol (25 mL) to obtain solution **I**. A solution of 5,5-dimethyl-1-pyrroline N-oxide in ethanol (10 μL, 0.2 mol/L) was added to solution **G** (50 μL). The obtained solution was placed in a sample capillary, which was placed in the instrument with a rubber seal at the bottom. The sample was scanned before light irradiation, and then every 45 s after starting irradiation by a mercury lamp. The same procedure was used for solution **H** (Fig. 6). An aliquot of solution **I** (150 μL) was taken and placed in the sample capillary, scanned once at low temperature (-183.15 °C) before light irradiation, and then every 45 s after irradiation by the mercury lamp.

6. General preparation procedure of Schiff bases

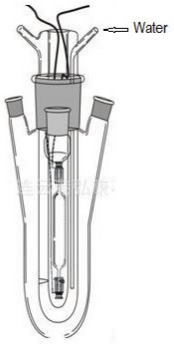


X = aryl or alkyl; R = H, methyl, nitro

Following the procedure of Liang et al,[1] to a solution of 2-amino-N-phenyl-benzamide (5.0 mmol) and toluene-p-sulfonic acid (0.05mmol) in 40 mL ethanol, furan-2-carbaldehyde (5.5 mmol) was added at room temperature. The resulting mixture was refluxed for 5–6 h and then filtered. The crude product was recrystallized from ethanol. The yields were 70–90%.

7. General procedure of photocatalysis

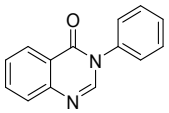
2-{[(5-Methylfuran-2-yl)methylene]amino}-*N*-phenylbenzamide **2** (1 mmol) was dissolved in ethanol (250 mL) in an inner irradiation photoreactor (250 mL) which has a tap water cooling trap. Then $CuCl_2$ (0.05 mmol) and CsOAc (1 mmol) were added. The resulting solution was stirred and irradiated by light (365–600 nm) for 5 h at room temperature (~25 °C). After TLC showed complete consumption of **2**, the reaction solution was evaporated to remove the solvent. The residue was dissolved in ethyl acetate, and then washed with H_2O and aqueous NH_4Cl. The organic layer was collected and dried with anhydrous Na_2SO_4. The products were purified by silica gel column chromatography ($V_{ethyl\ acetate}$:$V_{petroleum}$ = 1/5 to 1/3).



Inner irradiation photoreactor

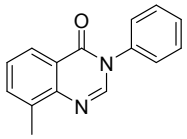
8. Characterization Data

The characterization data of **3**–**34** are given below.



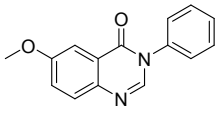
3-phenylquinazolin-4(3*H*)-one (3)

3 was obtained as yellow solid (171 mg, 77% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.39-8.36 (dd, *J* = 8.1, 1.4 Hz, 1H), 8.14 (s, 1H), 7.83-7.77 (m, 2H), 7.56 (t, *J* = 7.6 Hz, 3H), 7.52-7.48 (m, 1H), 7.44-7.41 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.8, 147.9, 146.2, 137.5, 134.7, 129.7, 129.2, 127.7, 127.6, 127.2, 127.1, 122.4. HRMS (ESI, *m/z*) Calcd for $C_{14}H_{11}N_2O$ $[M+H]^+$: 223.0866, found: 223.0865.



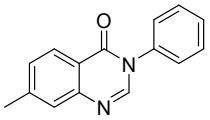
8-methyl-3-phenylquinazolin-4(3*H*)-one (4)

4 was obtained as yellow solid (170 mg, 72% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.22 (d, *J* = 8.1 Hz, 1H), 8.16 (s, 1H), 7.65 (d, *J* = 7.3 Hz, 1H), 7.57-7.53 (m, 2H), 7.51-7.47 (m, 1H), 7.45-7.41 (m, 3H), 2.66 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.1, 146.4, 144.9, 137.6, 136.0, 135.3, 129.7, 129.1, 127.3, 127.0, 124.9, 122.4, 17.6. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{13}N_2O$ $[M+H]^+$: 237.1022, found: 237.1022.



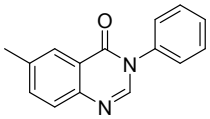
6-methoxy-3-phenylquinazolin-4(3*H*)-one (5)

5 was obtained as yellow solid (161 mg, 64% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.05 (s, 1H), 7.73-7.70 (m, 2H), 7.58-7.53 (m, 2H), 7.51-7.48 (m, 1H), 7.44-7.38 (m, 3H), 3.93 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.7, 159.1, 144.1, 142.3, 137.7, 129.7, 129.1, 127.1, 124.7, 123.3, 106.7, 55.9. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{13}N_2O_2$ $[M+H]^+$: 253.0972, found: 253.0972.



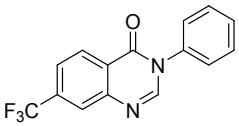
7-methyl-3-phenylquinazolin-4(3*H*)-one (6)

6 was obtained as yellow solid (184 mg, 78% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.25 (d, *J* = 8.2 Hz, 1H), 8.10 (s, 1H), 7.57-7.53 (m, 3H), 7.51-7.46 (m, 1H), 7.43-7.41 (m, 2H), 7.38-7.35 (dd, *J* = 8.1, 1.4 Hz, 1H), 2.54 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.7, 148.0, 146.2, 145.8, 137.6, 129.7, 129.3, 129.1, 127.4, 127.1, 119.9, 22.0. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{13}N_2O$ $[M+H]^+$: 237.1022, found: 237.1023.



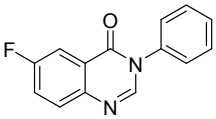
6-methyl-3-phenylquinazolin-4(3*H*)-one (7)

7 was obtained as yellow solid (194 mg, 82% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.15 (s, 1H), 8.08 (s, 1H), 7.66 (d, *J* = 8.1 Hz, 1H), 7.62-7.60 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.55 (t, *J* = 7.6 Hz, 2H), 7.50-7.46 (m, 1H), 7.43-7.41 (dd, *J* = 8.1, 1.4 Hz, 2H), 2.51 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.6, 145.6, 145.3, 137.9, 137.5, 135.9, 129.5, 129.0, 127.2, 126.9, 126.5, 121.9, 21.3.HRMS (ESI, *m/z*) Calcd for $C_{15}H_{13}N_2O$ $[M+H]^+$: 237.1022, found: 237.1022.



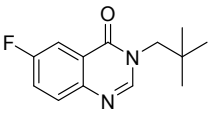
3-phenyl-7-(trifluoromethyl)quinazolin-4(3*H*)-one (8)

8 was obtained as yellow solid (172 mg, 59% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.48 (d, *J* = 8.4 Hz, 1H), 8.20 (s, 1H), 8.05 (s, 1H), 7.75 (d, *J* = 8.1 Hz, 1H), 7.60-7.50 (m, 3H), 7.44-7.42 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.0, 147.9, 147.4, 137.0, 136.7, 136.4, 136.0, 135.7, 129.9, 129.5, 128.4, 126.9, 125.3, 125.2, 124.8, 123.8, 122.0. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{10}F_3N_2O$ $[M+H]^+$: 291.0740, found: 291.0739.



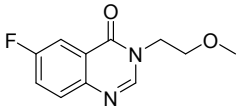
6-fluoro-3-phenylquinazolin-4(3*H*)-one (9)

9 was obtained as yellow solid (170 mg, 71% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.10 (s, 1H), 8.01-7.98 (dd, *J* = 8.4, 2.8 Hz, 1H), 7.80-7.76 (dd, *J* = 9.0, 5.0 Hz, 1H), 7.58-7.48 (m, 4H), 7.43-7.40 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 162.7, 160.2, 160.1, 145.5, 144.5, 137.3, 130.1, 130.0, 129.8, 129.3, 127.0, 123.8, 123.3, 123.1, 112.3, 112.1. HRMS (ESI, *m/z*) Calcd for $C_{14}H_{10}FN_2O$ $[M+H]^+$: 241.0772, found: 241.0770.



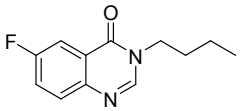
6-fluoro-3-neopentylquinazolin-4(3*H*)-one (10)

10 was obtained as yellow solid (190 mg, 81% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.97 (s, 1H), 7.96-7.93 (dd, *J* = 8.7, 3.0 Hz, 1H), 7.73-7.69 (dd, *J* = 9.0, 4.8 Hz, 1H), 7.50-7.45 (m, 1H), 3.89 (s, 2H), 1.03 (s, 9H).^{13}C NMR (100 MHz, $CDCl_3$): δ 162.3, 160.9, 159.9, 146.9, 144.6, 129.9, 129.8, 123.6, 122.9, 122.6, 112.1, 111.8, 56.6, 33.9, 27.8. HRMS (ESI, *m/z*) Calcd for $C_{13}H_{16}FN_2O$ $[M+H]^+$: 235.1241, found: 235.1240.



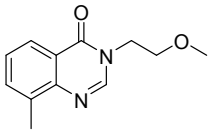
6-fluoro-3-(2-methoxyethyl)quinazolin-4(3*H*)-one (11)

11 was obtained as yellow solid (130 mg, 59% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.06 (s, 1H), 7.95-7.92 (dd, *J* = 8.4, 2.8 Hz, 1H), 7.74-7.70 (dd, *J* = 9.0, 4.8 Hz, 1H), 7.50-7.45 (m, 1H), 4.19 (t, *J* = 4.8 Hz, 2H), 3.68 (t, *J* = 5.0 Hz, 2H), 3.33 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 162.3, 160.5, 159.8, 147.6, 146.8, 144.9, 134.3, 130.0, 129.9, 127.4, 127.2, 126.7, 123.3, 123.0, 122.7, 111.7, 111.5, 69.9, 59.1, 46.8. HRMS (ESI, *m/z*) Calcd for $C_{11}H_{12}FN_2O_2$ $[M+H]^+$: 223.0877, found: 223.0876.



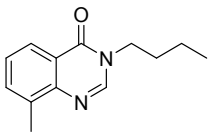
3-butyl-6-fluoroquinazolin-4(3*H*)-one (12)

12 was obtained as yellow solid (139 mg, 63% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.00 (s, 1H), 7.95-7.92 (dd, *J* = 8.7, 3.0 Hz, 1H), 7.73-7.70 (dd, *J* = 9.0, 4.8 Hz, 1H), 7.50-7.45 (m, 1H), 4.01 (t, *J* = 7.3 Hz, 2H), 1.82-1.74 (m, 2H), 1.46-1.37 (m, 2H), 0.98 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 162.4, 160.4, 159.9, 146.7, 145.9, 144.8, 134.2, 129.9, 129.8, 127.4, 127.3, 126.8, 123.5, 122.9, 122.7, 111.8, 111.5, 47.0, 31.4, 19.9, 13.7. HRMS (ESI, *m/z*) Calcd for $C_{12}H_{14}FN_2O$ $[M+H]^+$: 221.1085, found: 221.1083.



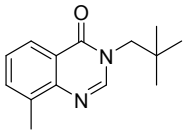
3-(2-methoxyethyl)-8-methylquinazolin-4(3*H*)-one (13)

13 was obtained as yellow solid (146 mg, 67% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.17-8.15 (dd, *J* = 8.1, 0.8 Hz, 1H), 8.12 (s, 1H), 7.61-7.58 (m, 1H), 7.38 (t, *J* = 7.6 Hz, 1H), 4.18 (t, *J* = 5 Hz, 2H), 3.68 (t, *J* = 5 Hz, 2H), 3.32 (s, 3H), 2.62 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.5, 146.8, 146.4, 135.8, 134.9, 126.7, 124.4, 122.1, 70.0, 59.0, 46.6, 17.5. HRMS (ESI, *m/z*) Calcd for $C_{12}H_{15}N_2O_2$ $[M+H]^+$: 219.1128, found: 219.1126.



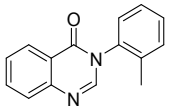
3-butyl-8-methylquinazolin-4(3*H*)-one (14)

14 was obtained as yellow solid (155 mg, 72% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.18-8.15 (dd, *J* = 7.8, 0.6 Hz, 1H), 8.05 (s, 1H), 7.60-7.58 (m, 1H), 7.38 (t, *J* = 7.6 Hz, 1H), 4.00 (t, *J* = 7.4 Hz, 2H), 2.61 (s, 3H), 1.81-1.74 (m, 2H), 1.44-1.38 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.4, 146.7, 145.5, 135.7, 134.8, 126.9, 124.4, 122.2, 46.8, 31.4, 19.9, 17.5, 13.7. HRMS (ESI, *m/z*) Calcd for $C_{13}H_{17}N_2O$ $[M+H]^+$: 217.1335, found: 217.1334.



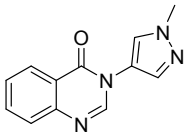
8-methyl-3-neopentylquinazolin-4(3*H*)-one (15)

15 was obtained as yellow solid (187 mg, 81% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.18-8.16 (m, 1H), 8.04 (s, 1H), 7.61-7.59 (m, 1H), 7.38 (t, *J* = 7.9 Hz, 1H), 3.89 (s, 2H), 2.62 (s, 3H), 1.03 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.9, 146.5, 135.7, 134.8, 126.8, 124.8, 122.3, 56.4, 33.9, 27.8, 17.5. HRMS (ESI, *m/z*) Calcd for $C_{14}H_{19}N_2O$ $[M+H]^+$: 231.1492, found: 231.1491.



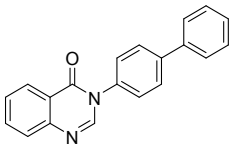
3-(o-tolyl)quinazolin-4(3*H*)-one (16)

16 was obtained as yellow solid (178 mg, 75% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.39-8.37 (dd, *J* = 8.1, 1.4 Hz, 1H), 8.01 (s, 1H), 7.85-7.78 (m, 2H), 7.59-7.54 (m, 1H), 7.43-7.35 (m, 3H), 7.26-7.25 (m, 1H), 2.21 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.5, 148.1, 146.4, 136.7, 135.9, 134.7, 131.4, 129.9, 127.9, 127.7, 127.4, 127.2, 122.5, 17.8. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{13}N_2O$ $[M+H]^+$: 237.1022, found: 237.1023.



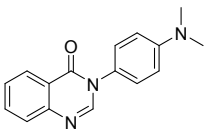
3-(1-methyl-1*H*-pyrazol-4-yl)quinazolin-4(3*H*)-one (17)

17 was obtained as yellow solid (149 mg, 66% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.37-8.35 (dd, *J* = 8.2, 1.4 Hz, 1H), 8.21 (s, 1H), 7.92 (s, 1H), 7.82-7.74 (m, 2H), 7.70 (s, 1H), 7.57-7.53 (m, 1H), 3.99 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.0, 147.4, 145.4, 134.6, 133.8, 127.8, 127.6, 127.1, 126.6, 122.1, 119.9, 39.8. HRMS (ESI, *m/z*) Calcd for $C_{12}H_{11}N_4O$ $[M+H]^+$: 227.0927, found: 227.0927.



3-([1,1'-biphenyl]-4-yl)quinazolin-4(3*H*)-one (18)

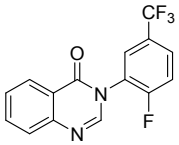
18 was obtained as yellow solid (264 mg, 89% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.39 (d, *J* = 8.1 Hz, 1H), 8.19 (s, 1H), 7.84-7.74 (m, 4H), 7.62 (d, *J* = 7.0 Hz, 2H), 7.59-7.55 (m, 1H), 7.51-7.46 (m, 4H), 7.40 (t, *J* = 7.0 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$): δ 160.9, 147.9, 146.1, 142.3, 139.9, 136.5, 134.7, 129.0, 128.4, 128.0, 127.8, 127.6, 127.3, 122.4. HRMS (ESI, *m/z*) Calcd for $C_{20}H_{15}N_2O$ $[M+H]^+$: 299.1179, found: 299.1179.



3-(4-(dimethylamino)phenyl)quinazolin-4(3*H*)-one (19)

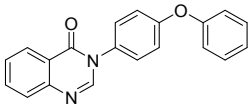
19 was obtained as yellow solid (186 mg, 70% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.37-8.35 (dd, *J* = 8.1, 1.1 Hz, 1H), 8.13 (s, 1H), 7.78-7.73 (m, 2H), 7.54-7.50 (m, 1H), 7.26-7.23 (dt, *J* = 9.0, 2.2 Hz, 2H), 6.81-6.78 (dt, *J* = 9.0, 2.2 Hz, 2H), 3.01 (s,

6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.4, 150.7, 148.0, 147.0, 134.4, 127.6, 127.5, 127.4, 127.2, 126.1, 122.5, 112.6, 40.5. HRMS (ESI, *m/z*) Calcd for $C_{16}H_{16}N_3O$ $[M+H]^+$: 266.1288, found: 266.1287.



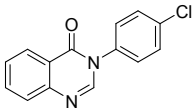
3-(2-fluoro-5-(trifluoromethyl)phenyl)quinazolin-4(3*H*)-one (20)

20 was obtained as yellow solid (286 mg, 93% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.38-8.36 (dd, *J* = 8.1, 1.4 Hz, 1H), 8.03 (m, 1H), 7.87-7.79 (m, 3H), 7.77-7.75 (dd, *J* = 6.4, 2.4 Hz, 1H), 7.61-7.57 (m, 1H), 7.46 (t, *J* = 9.0 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.8, 160.0, 158.2, 147.7, 145.0, 135.2, 128.8, 128.2, 127.9, 127.3, 125.8, 125.6, 124.4, 122.1, 121.7, 118.1, 117.9. HRMS (ESI, *m/z*) Calcd for $C_{15}H_9F_4N_2O$ $[M+H]^+$: 309.0646, found: 309.0647.



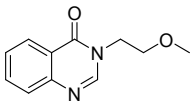
3-(4-phenoxyphenyl)quinazolin-4(3*H*)-one (21)

21 was obtained as yellow solid (247 mg, 79% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.38-8.35 (m, 1H), 8.13 (s, 1H), 7.82-7.75 (m, 2H), 7.57-7.53 (m, 1H), 7.42-7.34 (m, 4H), 7.20-7.15 (m, 1H), 7.15-7.13 (m, 1H), 7.12-7.08 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.0, 158.2, 156.2, 147.9, 146.2, 134.7, 132.0, 130.1, 128.5, 127.8, 127.6, 127.2, 124.3, 122.4, 119.8, 119.0. HRMS (ESI, *m/z*) Calcd for $C_{20}H_{15}N_2O_2$ $[M+H]^+$: 315.1128, found: 315.1128.



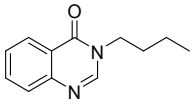
3-(4-chlorophenyl)quinazolin-4(3*H*)-one (22)

22 was obtained as yellow solid (194 mg, 76% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.36-8.34 (dd, *J* = 8.2, 1.4 Hz, 1H), 8.09 (s, 1H), 7.83-7.76 (m, 2H), 7.58-7.51 (m, 3H), 7.40-7.36 (m, 2H). ^{13}C NMR (100 MHz, DMSO): δ 160.4, 148.2, 147.4, 136.9, 135.2, 133.9, 130.0, 129.7, 128.0, 127.8, 126.9, 122.3. HRMS (ESI, *m/z*) Calcd for $C_{14}H_{10}ClN_2O$ $[M+H]^+$: 257.0476, found: 257.0475.



3-(2-methoxyethyl)quinazolin-4(3*H*)-one (23)

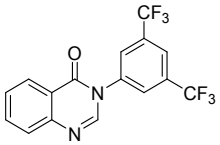
23 was obtained as yellow solid (165 mg, 81% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.32-8.30 (dd, *J* = 7.8, 1.1 Hz, 1H), 8.10 (s, 1H), 7.77-7.70 (m, 2H), 7.52-7.48 (m, 1H), 4.19 (t, *J* = 4.8 Hz, 2H), 3.68 (t, *J* = 4.8 Hz, 2H), 3.32 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.1, 148.2, 147.5, 134.3, 127.5, 127.1, 126.7, 122.1, 70.0, 59.0, 46.7. HRMS (ESI, *m/z*) Calcd for $C_{11}H_{13}N_2O_2$ $[M+H]^+$: 205.0972, found: 205.0973.



3-butylquinazolin-4(3*H*)-one (24)

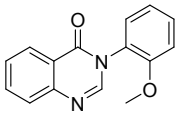
24 was obtained as yellow solid (164 mg, 81% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.33-8.30 (m, 1H), 8.03 (s, 1H), 7.77-7.69 (m, 2H), 7.52-7.48 (m, 1H), 4.01 (t, *J* = 7.6 Hz, 2H), 1.82-1.75 (m, 2H), 1.46-1.37 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H). ^{13}C

NMR (100 MHz, $CDCl_3$): δ 161.1, 148.1, 146.8, 134.2, 127.4, 127.3, 126.7, 122.2, 46.8, 31.5, 19.9, 13.7. HRMS (ESI, *m/z*) Calcd for $C_{12}H_{15}N_2O$ $[M+H]^+$: 203.1179, found: 203.1178.



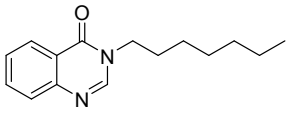
3-(3,5-bis(trifluoromethyl)phenyl)quinazolin-4(3*H*)-one (25)

25 was obtained as yellow solid (273 mg, 76% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.37-8.35 (dd, *J* = 7.8, 1.4 Hz, 1H), 8.12 (s, 1H), 8.02 (s, 1H), 7.96 (s, 2H), 7.88-7.84 (dt, *J* = 8.4, 1.4 Hz, 1H), 7.80 (d, *J* = 7.0 Hz, 1H), 7.62-7.58 (dt, *J* = 8.4, 1.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.4, 147.6, 144.4, 138.8, 135.3, 133.9, 133.5, 133.2, 132.8, 128.4, 128.0, 127.7, 127.3, 124.0, 123.1, 121.9, 121.3, 118.6. HRMS (ESI, *m/z*) Calcd for $C_{16}H_9F_6N_2O$ $[M+H]^+$: 359.0614, found: 359.0612.



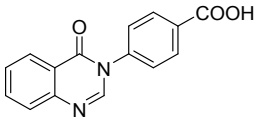
3-(2-methoxyphenyl)quinazolin-4(3*H*)-one (26)

26 was obtained as yellow solid (210 mg, 83% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.37 (d, *J* = 7.8 Hz, 1H), 7.98 (s, 1H), 7.80-7.75 (m, 2H), 7.55-7.51 (dt, *J* = 8.2, 1.7 Hz, 1H), 7.50-7.45 (dt, *J* = 7.6, 1.4 Hz, 1H), 7.35-7.33 (dd, *J* = 7.6, 1.4 Hz, 1H), 7.12-7.08 (m, 2H), 3.81 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.7, 154.7, 148.1, 147.3, 134.5, 131.0, 129.2, 127.5, 127.4, 127.2, 126.0, 122.7, 121.0, 112.3, 55.9. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{13}N_2O_2$ $[M+H]^+$: 253.0972, found: 253.0972.



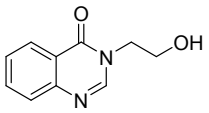
3-heptylquinazolin-4(3*H*)-one (27)

27 was obtained as yellow solid (176 mg, 72% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.33-8.30 (dd, *J* = 8.1, 1.4 Hz, 1H), 8.03 (s, 1H), 7.77-7.69 (m, 2H), 7.52-7.48 (m, 1H), 4.00 (t, *J* = 7.6 Hz, 2H), 1.83-1.76 (m, 2H), 1.39-1.26 (m, 8H), 0.87 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.1, 148.1, 146.7, 134.2, 127.4, 127.3, 126.7, 122.2, 47.2, 31.7, 29.4, 28.9, 26.7, 22.6, 14.1. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{21}N_2O$ $[M+H]^+$: 245.1648, found: 245.1648.



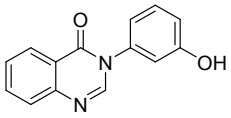
4-(4-oxoquinazolin-3(4*H*)-yl)benzoic acid (28)

(*E*)-4-(2-(((5-methylfuran-2-yl)methylene)amino)benzamido)benzoic acid (137 mg) was used to prepare **28**, and obtained 28 as yellow solid (44 mg, 42% yield); ^{1}H NMR (400 MHz, DMSO): δ 13.23 (s, 1H), 8.39 (s, 1H), 8.22-8.20 (dd, *J* = 8.1, 1.1 Hz, 1H), 8.10 (d, *J* = 8.4 Hz, 2H), 7.91-7.87 (m, 1H), 7.75 (d, *J* = 7.8 Hz, 1H), 7.70 (d, *J* = 8.4 Hz, 2H), 7.63-7.59 (m, 1H). ^{13}C NMR (100 MHz, DMSO): δ 167.1, 160.3, 148.1, 147.2, 141.7, 135.3, 131.4, 130.6, 128.3, 128.0, 127.9, 127.0, 122.3. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{11}N_2O_3$ $[M+H]^+$: 267.0764, found: 267.0765.



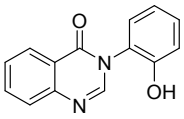
3-(2-hydroxyethyl)quinazolin-4(3*H*)-one (29)

29 was obtained as yellow solid (96 mg, 51% yield); ^{1}H NMR (400 MHz, DMSO): δ 8.26 (s, 1H), 8.16 (d, *J* = 7.8 Hz, 1H), 7.81 (t, *J* = 8.1 Hz, 1H), 7.67 (d, *J* = 8.1 Hz, 1H), 7.53 (t, *J* = 7.8 Hz, 1H), 4.97 (s, 1H), 4.03 (t, *J* = 5.0 Hz, 2H), 3.67 (s, 2H). ^{13}C NMR (100 MHz, DMSO): δ 160.8, 149.1, 148.5, 134.7, 127.6, 127.3, 126.5, 122.1, 58.8, 49.1. HRMS (ESI, *m/z*) Calcd for $C_{10}H_{11}N_2O_2$ $[M+H]^+$: 191.0815, found: 191.0814.



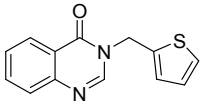
3-(3-hydroxyphenyl)quinazolin-4(3*H*)-one (30)

30 was obtained as brown solid (165 mg, 69% yield); ^{1}H NMR (400 MHz, DMSO): δ 9.91 (s, 1H), 8.31 (s, 1H), 8.20-8.18 (dd, *J* = 8.1, 1.1 Hz, 1H), 7.89-7.85 (m, 1H), 7.73 (d, *J* = 7.6 Hz, 1H), 7.61-7.57 (m, 1H), 7.36-7.32 (m, 1H), 6.93-6.90 (m, 3H). ^{13}C NMR (100 MHz, DMSO): δ 160.4, 158.4, 148.2, 147.6, 139.0, 135.1, 130.5, 127.9, 127.8, 126.9, 122.4, 118.3, 116.3, 115.1. HRMS (ESI, *m/z*) Calcd for $C_{14}H_{11}N_2O_2$ $[M+H]^+$: 239.0815, found: 239.0815.



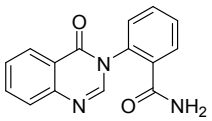
3-(2-hydroxyphenyl)quinazolin-4(3*H*)-one (31)

31 was obtained as yellow solid (173 mg, 73% yield); ^{1}H NMR (400 MHz, DMSO): δ 10.11 (s, 1H), 8.19-8.17 (m, 2H), 7.90-7.85 (m, 1H), 7.73 (d, *J* = 7.8 Hz, 1H), 7.60-7.56 (m, 1H), 7.37-7.32 (m, 2H), 7.05 (d, *J* = 8.1 Hz, 1H), 6.97-6.93 (m, 1H). ^{13}C NMR (100 MHz, DMSO): δ 160.3, 153.5, 148.7, 148.4, 135.0, 130.9, 129.9, 127.8, 127.7, 126.8, 125.2, 122.7, 119.8, 117.2. HRMS (ESI, *m/z*) Calcd for $C_{14}H_{11}N_2O_2$ $[M+H]^+$: 239.0815, found: 239.0817.



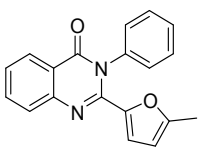
3-(thiophen-2-ylmethyl)quinazolin-4(3*H*)-one (32)

32 was obtained as yellow solid (154 mg, 63% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.34-8.32 (m, 1H), 8.15 (s, 1H), 7.77-7.68 (m, 2H), 7.53-7.49 (m, 1H), 7.28-7.26 (dd, *J* = 5.0, 1.1 Hz, 1H), 7.16-7.15 (m, 1H), 6.98-6.96 (dd, *J* = 5.0, 3.6 Hz, 1H), 5.35 (s, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.8, 148.0, 145.9, 137.5, 134.5, 127.9, 127.6, 127.5, 127.2, 126.9, 126.8, 122.1, 44.4. HRMS (ESI, *m/z*) Calcd for $C_{13}H_{11}N_2OS$ $[M+H]^+$: 243.0587, found: 243.0587.

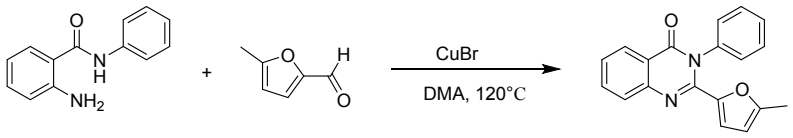


2-(4-oxoquinazolin-3(4*H*)-yl)benzamide (33)

33 was obtained as yellow solid (156 mg, 59% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.31-8.29 (m, 1H), 8.07 (s, 1H), 7.84-7.78 (m, 2H), 7.70-7.67 (dd, *J* = 7.6, 1.7 Hz, 1H), 7.61-7.51 (m, 3H), 7.32-7.30 (dd, *J* = 7.6, 1.4 Hz, 1H), 6.50 (s, 1H), 5.76 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 168.6, 161.8, 148.1, 146.1, 134.9, 134.8, 131.9, 130.1, 128.9, 128.8, 127.9, 127.7, 127.1, 122.0. HRMS (ESI, *m/z*) Calcd for $C_{15}H_{12}N_3O_2$ $[M+H]^+$: 266.0924, found: 266.0925.



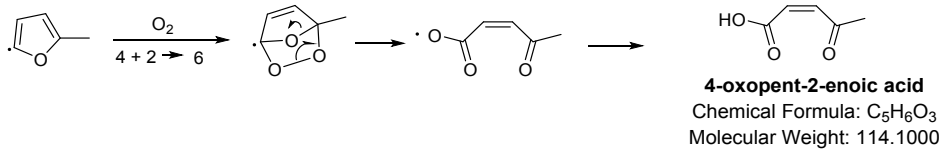
2-(5-methylfuran-2-yl)-3-phenylquinazolin-4(3*H*)-one (34)



A mixture of 2-amino-*N*-phenylbenzamide (1.0 mmol), 5-methylfuran-2-carbaldehyde (1.0 mmol), and CuBr (0.1 mmol) in *N,N*-dimethylacetamide (3 mL) was stirred at 120℃ for 12 h. Then the reaction mixture was cooled to room temperature, and the solvent was evaporated. The residual was purified by column chromatography on silica gel (gradient eluent with a mixed solution of petroleum ether and ethyl acetate) to give the pure 2-(5-methylfuran-2-yl)-3-phenylquinazolin-4(*3H*)-one. Compound **34** was obtained as a yellow solid (212 mg, 70% yield); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.30-8.27 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.85 (d, *J* = 7.8 Hz, 1H), 7.80-7.76 (dt, *J* = 8.1, 1.4 Hz, 1H), 7.56-7.52 (m, 3H), 7.49-7.45 (m, 1H), 7.34-7.30 (m, 2H), 5.86 (d, *J* = 3.6 Hz, 1H), 5.43 (d, *J* = 3.6 Hz, 1H), 2.30 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 162.4, 156.1, 147.8, 145.4, 144.4, 137.8, 134.8, 129.7, 129.5, 128.9, 127.8, 127.1, 126.9, 120.5, 118.5, 108.6, 13.9. HRMS (ESI, *m/z*) Calcd for $C_{19}H_{15}N_2O_2$ $[M+H]^+$: 303.1128, found: 303.1129.

9. The decomposition of furan moiety

Compound **2** (1 mmol) was dissolved in ethanol (250 mL) in the 250-mL internal irradiation reactor equipped with a tap water cooling trap, and $CuCl_2$ (0.05 mmol) and CsOAc (1 mmol) were added. The resulting solution was stirred and irradiated by light (365–600 nm) for 1 h at room temperature (~25 °C). Then, the solvent was removed, and the residue was added to ethyl acetate (20 mL) and water (20 mL). The resulting mixture was treated with ethylenediamine tetraacetic acid (0.5 mmol) to remove the copper ion. The organic phase was evaporated to remove 95% of the ethyl acetate. The residue liquid was used for MS analysis. It was found that the furan moiety may be oxidized to produce 4-oxopent-2-enoic acid [2] which could be an important renewable furan building block. (Fig. S8, S9, and S10).



10. Supplementary figures

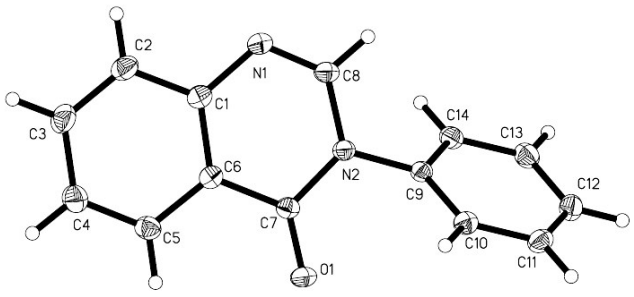


Fig. S1 Single-crystal structure of compound **3**.[3,4]

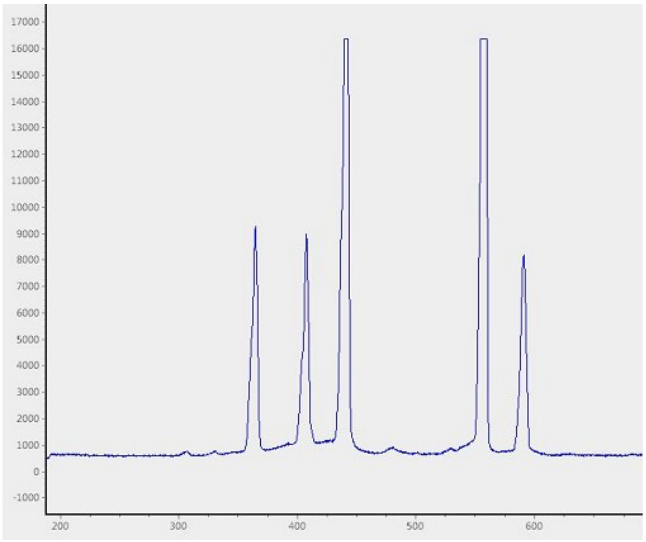


Fig. S2 Output spectrum of the high-voltage mercury lamp.

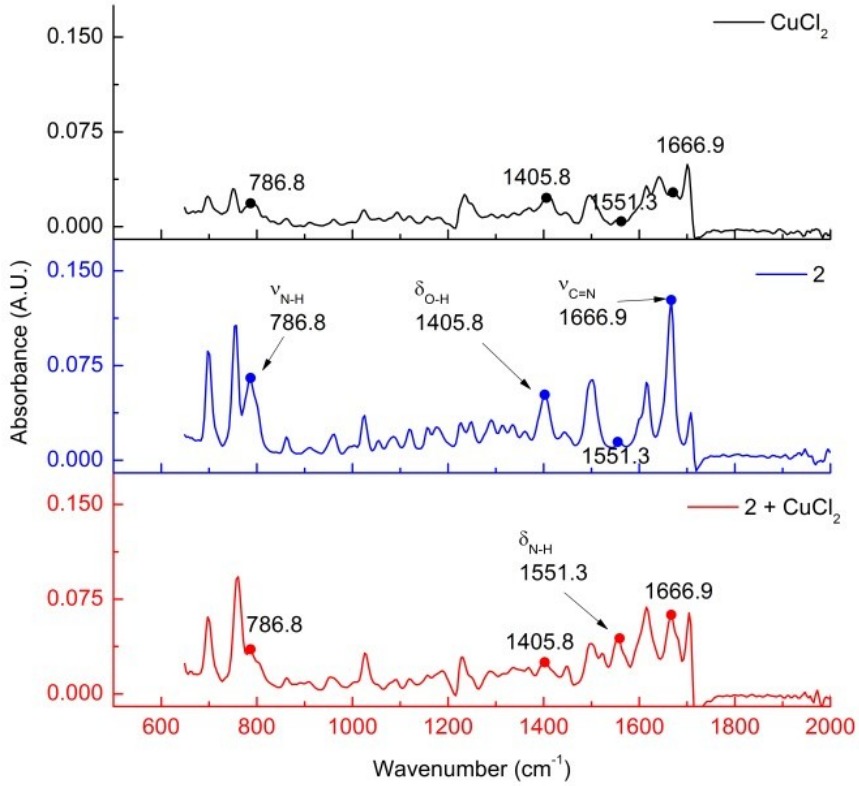


Fig. S3 IR spectra of **2** (0.25 mmol/mL), $CuCl_2$ (0.11 mmol/mL), and **2** (0.25 mmol/mL) + $CuCl_2$ (0.16 mmol/mL) in acetone.

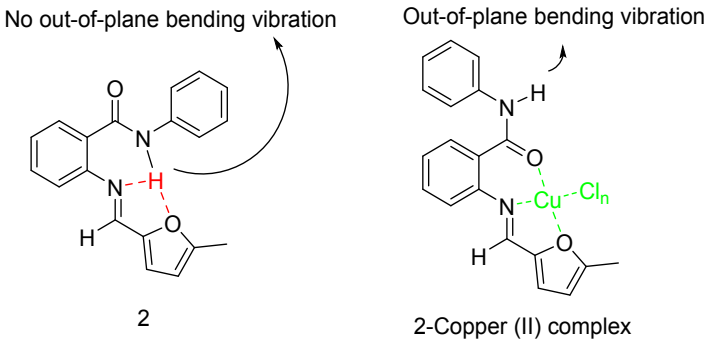


Fig. S4 Difference of out-of-plane bending vibration signals ($\delta_{N\text{-}H}$:1551.3 cm^{-1}) between **2** and **2**-copper (II) complex.

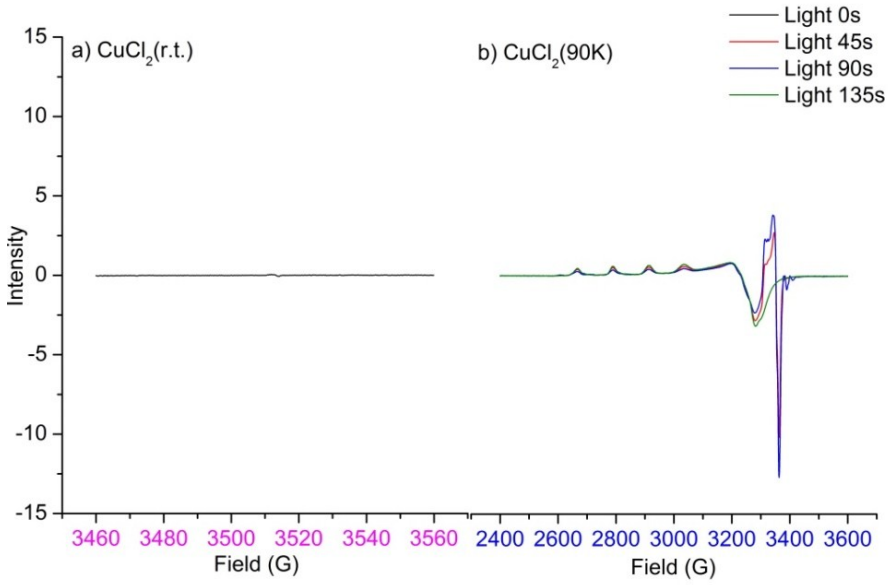


Fig. S5 EPR signal of copper (II).

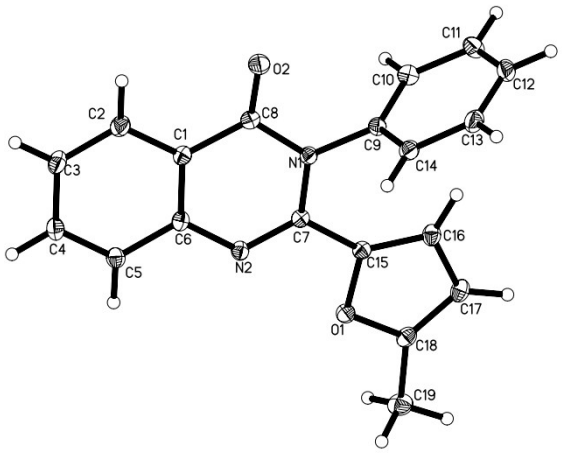


Fig. S6 Single-crystal structure of compound **34**.[3,4]

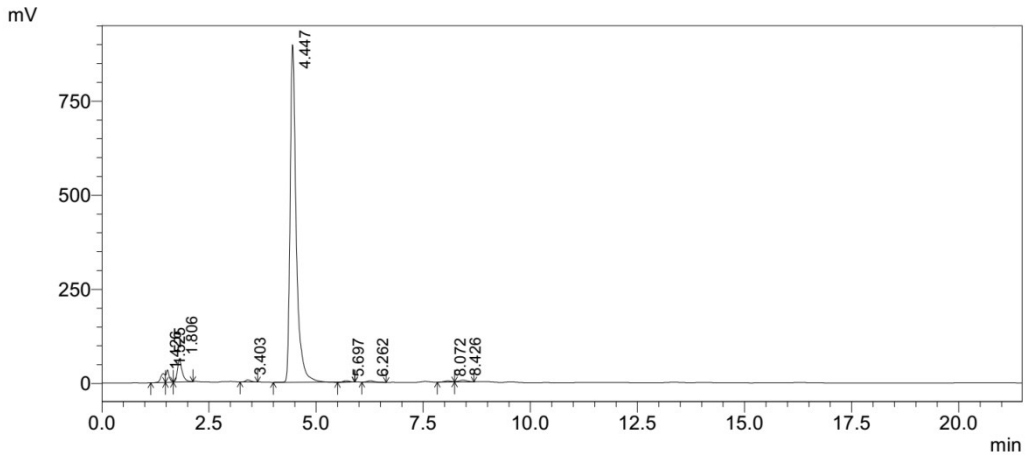


Fig. S7 HPLC spectrum of entry 27 in Table 1.

Qualitative Analysis Report

Data Filename	1614.d	**Sample Name**	YWJ1604
Instrument Name	TOF G6230A	**Acquired Time**	2018-02-28
Acq Method	YCL.M	**Acquired SW**	6200 series TOF/6500 series
IRM Calibration Status	Success		
User Chormatograms			

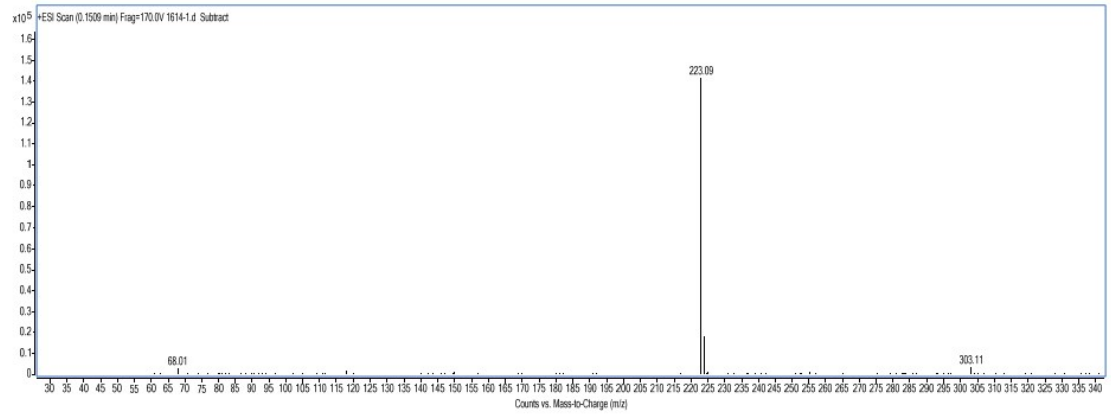


Fig. S8 MS results of furan moiety decomposition reaction solution (positive-ion mode).

Qualitative Analysis Report

Data Filename	1690.d	**Sample Name**	YWJ1608
Instrument Name	TOF G6230A	**Acquired Time**	2018-03-05
Acq Method	YCL.M	**Acquired SW**	6200 series TOF/6500 series
IRM Calibration Status	**Success**		

User Chormatograms

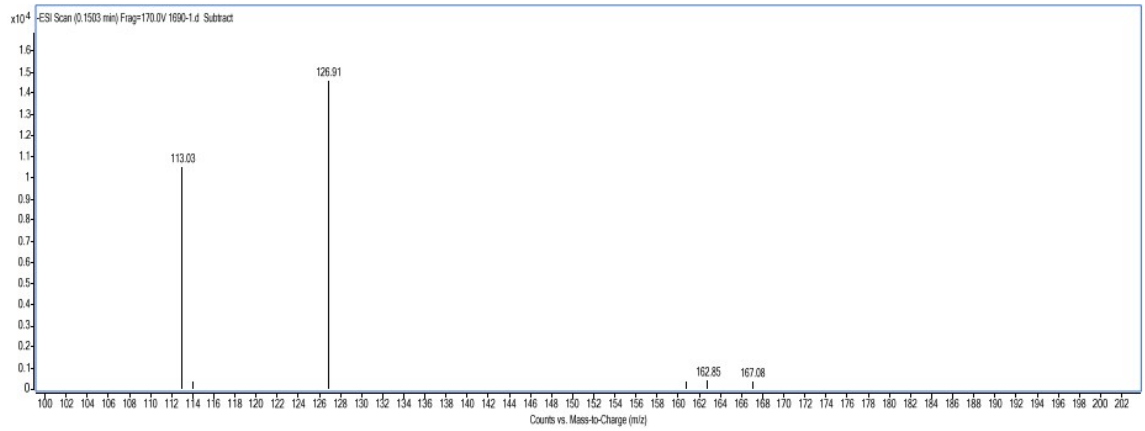


Fig. S9 MS results of furan moiety decomposition reaction solution (negative-ion mode).

Qualitative Analysis Report

Data Filename	1692.d	**Sample Name**	YWJ1608
Instrument Name	TOF G6230A	**Acquired Time**	2018-03-06
Acq Method	YCL.M	**Acquired SW**	6200 series TOF/6500 series
IRM Calibration Status	**Success**		

User Chormatograms

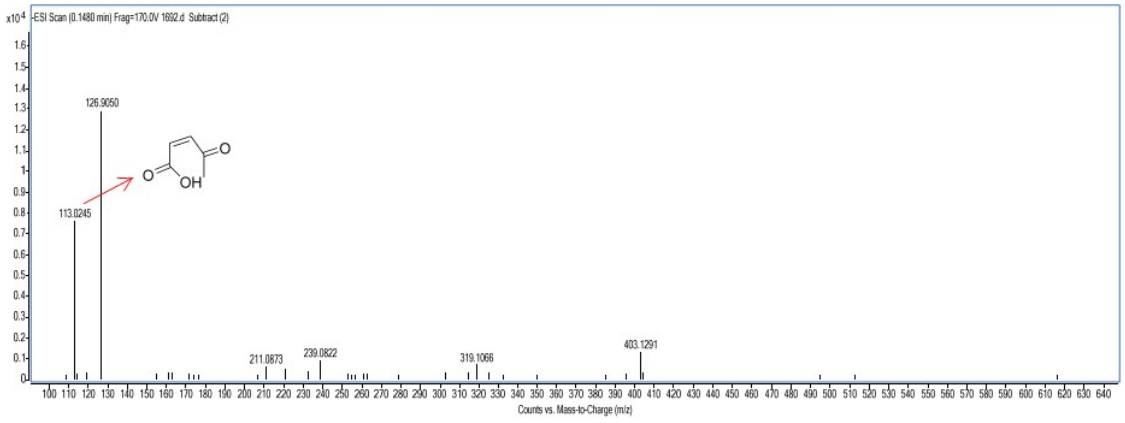


Fig. S10 HRMS results of furan moiety decomposition reaction solution (negative-ion mode).

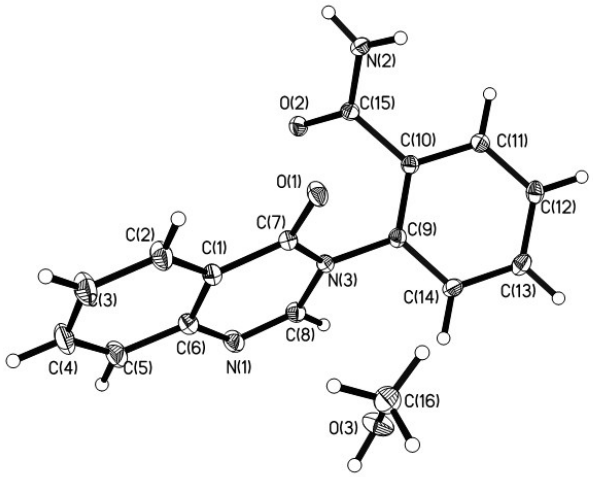


Fig. S11 Single crystal structure of compound **33**[3,4]

References

[1] Y. Liang, B. Su, J. Zhao and W. Sun, *Synth. Commun.,* 2004, **34**, 3235-3242.

[2] (*a*) G. O. Schenck, *Justus Liebigs Ann. Chem.,* 1953, **584**, 156-176; (*b*) M. R. Mahran, M. M. Sidky, and H. Wamhoff, *Chemosphere*, 1983, **12**, 1653-1657.

[3] O. V. Dolomanov, L. J. Bourhis, R. J. Gildea, J. A. K. Howard and H. Puschmann, *J. Appl. Cryst.*, 2009, **42**, 339.

[4] G. M. Sheldrick, *Acta Cryst.*, 2015, **C71**, 3.