Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Photocatalytic directing group activated Intramolecular Imine C-H bond

Xuhong Ren, Qiyang Wang, Wenjia Yu, Xiaoyu Zhan,Yishan Yao, Bingjie Qin, Mingxin Dong*, Xinhua He*

Abstract: Photocatalysis is a powerful method for organic synthesis because of the lack of side products/waste materials and high efficiency, but suitable reaction types are still underexplored. We induced directing group notion into photocatalysis to activate C-H bond through light treatment only if any metal-directing group complexes were photoinitiators. Herein, We found that conjugated *N*,*O*-bidentate copper (II) complexes could be used as novel photocatalytic directing groups, and thereby could activate their intramolecular imine C(sp^2)-H to produce the corresponding cyclized products via an UV triggered free radical mechanism.

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A. General considerations

All reactions were carried out under an inert atmosphere of air in oven - dried glassware, unless otherwise noted. Conventional solvents (EtOH, THF, CH_2Cl_2, toluene, acetone) were dried. $CuCl_2$ was purchased from commercial sources, and all other reagents were purchased commercially and used as received, unless otherwise noted. Compounds were purified by silica columns. Photoredox reactions were irradiated with high pressure mercury lamp, and the temperature (~ 30 °C) was controlled using a condenser tube. Melting points (°C) were uncorrected. Mass spectra (ESI) were recorded using acetone as the solvent. NMR Spectra (^1H, ^{13}C) were performed at 298 K. ^1H (400 MHz) and ^{13}C (100 MHz) NMR chemical shifts are reported relative to internal TMS (δ = 0.00 ppm) . Data are presented as follows: chemical shift (ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, sept = septet, m = multiplet, br = broad), coupling constant *J* (Hz) and integral.

B. General procedure of the solution of methyl violet decolorized assay

Methyl violet (74.7 mg) was dissolved in acetone (50 mL) to get the solution of methyl violet (4 mM) for further use. The reaction solution was inputted air consecutively and treated by UV light (500 W) , and then fractions (5 mL) were taken and added into methyl violet solution (0.15 mL) directly to test their ability of making methyl violet solution decolorized. a) *N*'-benzylidenebenzohydrazide (446 mg, 2 mmol) was dissolved in acetone (1200 mL). The resulting mixture was stirred and treated by UV light (500 W), and then fractions of this mixture solution (5 mL) were tested at the time of 0 min, 5 min, 15 min, and 25 min. And it was found those fraction solutions could not decolorize methyl violet solution. b) Copper chloride (134 mg, 1 mmol) was added into acetone (1200 mL) and was stirred vigorously. The resulting solution was treated by UV light (500 W), and then fractions of this solution (5 mL) were tested at the time of 0 min, 5 min, 15 min, and 25 min. It was found those fraction solutions could not cause methyl violet solution decolorized. c) *N*'-benzylidenebenzohydrazide（446 mg, 2 mmol） was dissolved in acetone (1200 mL), and then copper chloride (134 mg, 1 mmol) was added. After stirring for 5 min, the resulting solution was clear, and then treated with UV light (500 W). Fractions of this solution (5 mL) were tested at the time of 0 min, 5 min, 15 min, and 25 min. And it was found that fraction solutions of 0 min and 25 min did not decolorize methyl violet solution, but fraction solutions of 5 min and 15 min did. This suggested that no free radicals were generated without UV treatment and the free radicals were exhausted in 25 min.

C. EPR test

a) Solution of *N*'-benzylidenebenzohydrazide (446 mg, 2 mmol) in acetone (1200 mL) was inputted air consecutively and treated with UV light (500 W). Fraction solution was tested at the time of 0 min and 15 min of UV treatment for electron paramagnetic resonance spectrum test; b) Solution of copper chloride (134 mg, 1 mmol) in acetone (1200 mL) was inputted air consecutively and treated wtih UV light (500 W). Fraction solution was tested at the time of 0 min and 15 min of UV treatment for electron paramagnetic resonance spectrum test; c) Solution of *N*'-benzylidenebenzohydrazide (446 mg, 2 mmol) and copper chloride (134 mg, 1 mmol) in acetone (1200 mL) was inputted air consecutively and treated with UV light (500 W). Fraction solution was tested at the time of 0 min, 5 min, 10 min and 15 min of UV treatment for electron paramagnetic resonance spectrum test.

b) Electron paramagnetic resonance spectrum test conditions:

Apparatus: JEOL FEIXG-ESR Temperature : 25°C

Wavelength: X-band, 100 kHa Amplitude modulation: 5×10^{-4} T

Power: 4 mW Swept field: l000×10^{-4} T

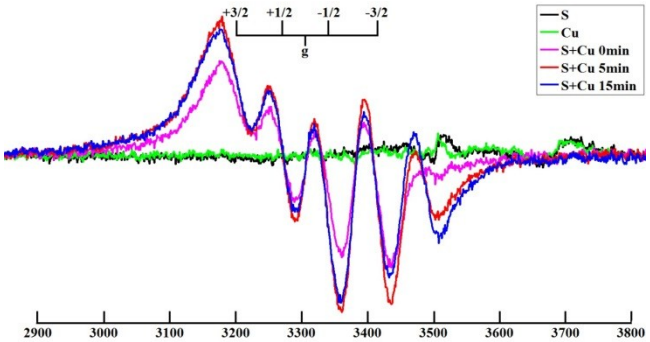


Figure 2. Electron paramagnetic resonance spectrum of benzylidenebenzohydrazide and copper (II) chloride complex.

D. Ultraviolet-Visible absorbance spectroscopy

UV-Vis absorbance spectra were obtained using a Unico UV-4802 spectrophotometer. **1** (1mg) and $CuCl_2$ (1mg) were resolved in DMSO (1mL) respectively, and 10 μ L 1 solution (1mg/mL) was diluted to 100 μ L using DMSO, then test its spectroscopy. 10 μ L solution of **1** (1mg/mL) and 10 μ L solution of $CuCl_2$ (1mg/mL) were mixed, then diluted to 100 μ L using DMSO and test its spectroscopy. Spectra were acquired in a 1 cm pathlength quartz in room temperature, and measurements were done by carrying out wavelength scans with a narrow slit width at specific time intervals. The extinction coefficient of 1 at 304 nm is 34, 267 L.mol-1.cm-1, and the extinction coefficient of **1** with $CuCl_2$ at 339 nm is 216,119 L.mol-1.cm-1.

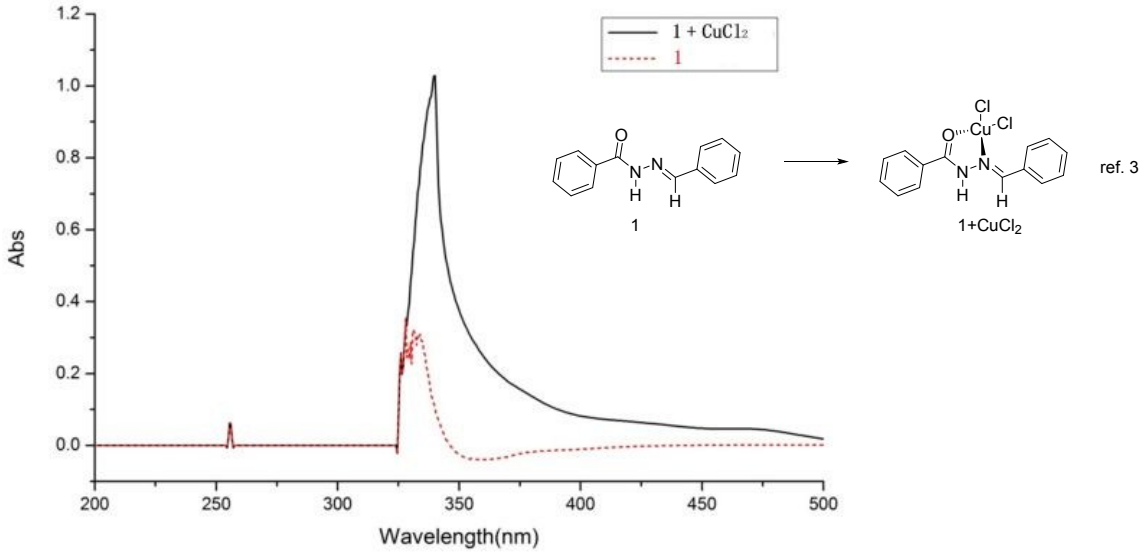


Figure 3. UV/Vis spectra of benzylidenebenzohydrazide and benzylidenebenzohydrazide - copper complex.

E. Single crystals culture and X-ray analysis

Single crystals of 2-(3-fluorophenyl)-3-phenyl-2,3-dihydroquinazolin-4(*1H*)-one were obtained by slow evaporation of an ethyl acetate solution at room temperature (20°C). A suitable crystal was selected and tested on a SuperNova, Dual, Cu at home/near, AtlasS2 diffractometer. The crystal was kept at 100.01 (10) K during data collection. Using Olex2[1] , the structure was solved with the ShelXT[2] structure solution program using Direct Methods and refined with the ShelXL refinement package using Least Squares minimization.

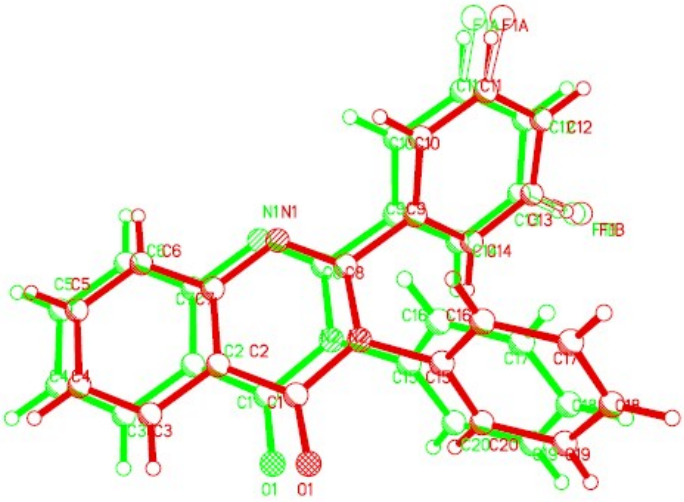


Figure 4. Molecular structure shown with the atom - labeling scheme

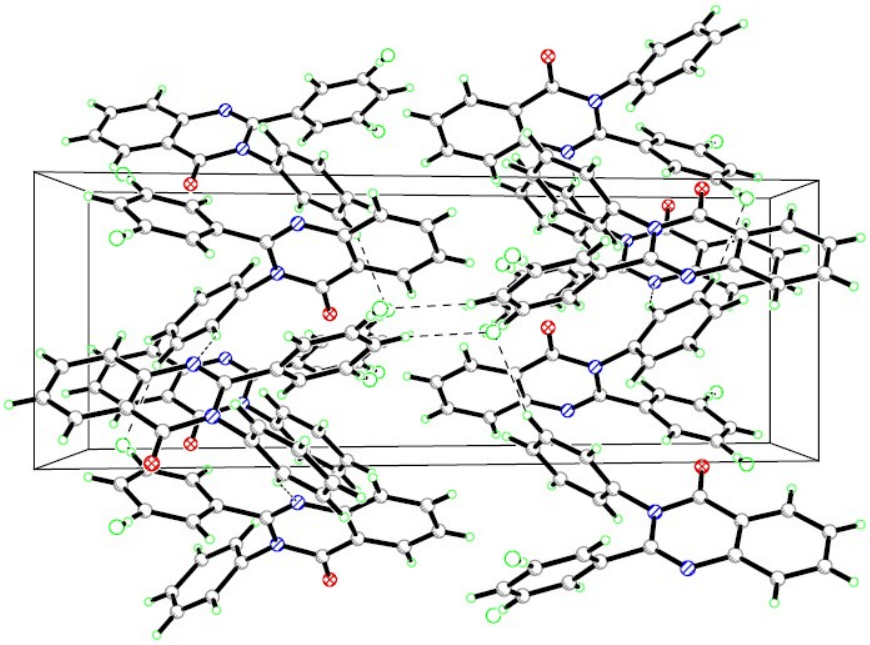
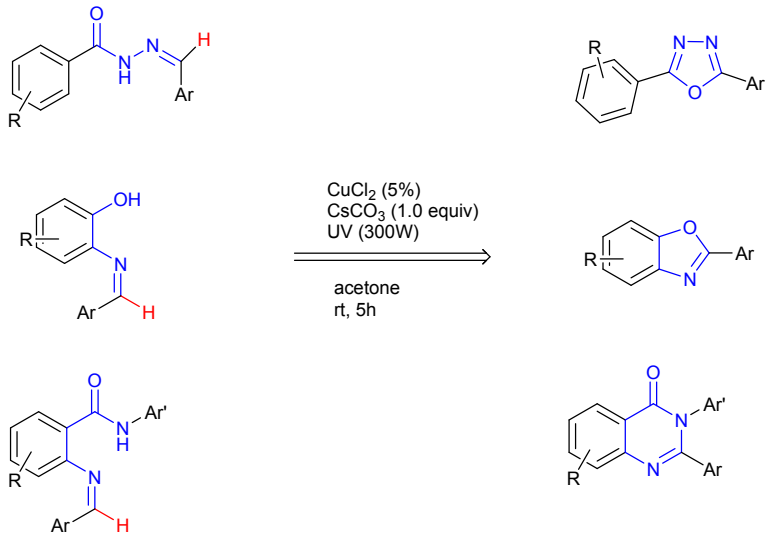


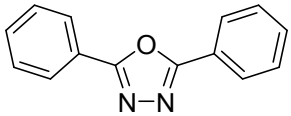
Figure 5. The crystal packing showing the molecules connected by C - H···F hydrogen bindings (dashed lines).

F. General procedure for oxidative cross-coupling reactions



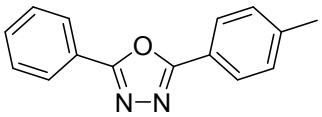
1.0 mmol scale reaction: To an 250 mL clear glass vial equipped with a Teflon-coated magnetic stir bar was added acetone (120 mL) and SM1 (1.0 mmol, 1 equiv). The resulting solution was added $CuCl_2$ (0.05 mmol, 0.05 equiv) and Cs_2CO_3 (1.0 mmol, 1.0 equiv) and input air continuously. The temperature of reaction mixture was kept at 25-30 °C. The reaction was monitored by TLC two hours after UV treatment. Removed acetone after SM1 was disappeared, and the residue was added dichloromethane (100 mL), washed by water (30 mL × 3). The organic layer was collected and dried by anhydrous Na_2SO_4. The products were purified by silica columns (ethyl acetate/ petroleum = 1/10 ~ 1/4 v/v). Gram scale products can be obtained by using same procedure.

G. Characterization Data



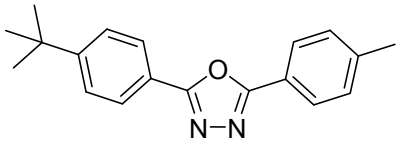
2,5-Diphenyl-1,3,4-oxadiazole (2)

Obtained as white solid (140 mg, 63%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 126128 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.12-8.14 (m, 4H), 7.50 - 7.56 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.5, 131.7, 129.0, 126.9, 123.8; HRMS (*m/z*) (M+1) calcd for $C_{14}H_{10}N_2O$: 223.0866, found 223.0866.



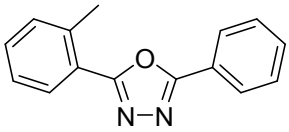
2-Phenyl-5-p-tolyl-1,3,4-oxadiazole (3)

Obtained as white solid (128 mg, 54%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 95-97 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.13-8.15 (dd, J_1 = 8.0 Hz, J_2 = 2.0 Hz, 2H), 8.00-8.04 (d, J = 8.0 Hz, 2H), 7.50-7.54 (m, 3H), 7.32 (d, J = 8.0 Hz,2H), 2.42 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.9, 164.5, 142.5, 131.9, 130.4, 130.0, 129.4, 129.9, 129.3, 127.1, 124.2, 121.3, 21.9. HRMS (*m/z*) (M+1) calcd for $C_{15}H_{12}N_2O$: 237.0128, found 237.1022.



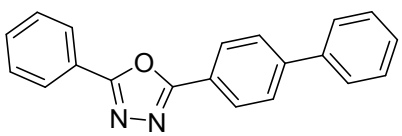
2-(4-(tert-butyl)phenyl)-5-(p-tolyl)-1,3,4-oxadiazole (4)

Obtained as white solid (155 mg, 53%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 95-97 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.02-8.07 (m, 4H), 7.54 (d, J = 8.4 Hz, 2H), 7.32 (d, J = 8.4 Hz, 2H), 2.44 (s, 3H), 1.37 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.6, 155.3, 142.3, 129.8, 126.9, 126.8, 126.1, 121.3, 121.2, 35.2, 31.2, 21.8. HRMS (*m/z*) (M+1) calcd for $C_{19}H_{20}N_2O$: 293.1648, found 293.1648.



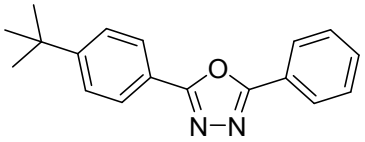
2-phenyl-5-(o-tolyl)-1,3,4-oxadiazole (5)

Obtained as white solid (107 mg, 45%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 88-90 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.12-8.15 (m, 2H), 8.03-8.05 (d, J = 8.0 Hz, 1H), 7.50 - 7.54 (m, 3H), 7.41-7.43 (m, 1H), 7.33-7.37 (d, J = 8.0 Hz, 2H), 2.77 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.8, 164.1, 138.4, 131.8, 131.6, 131.2, 129.0, 128.9, 126.8, 124.2, 123.38, 22.1. HRMS (*m/z*) (M+1) calcd for $C_{15}H_{12}N_2O$: 237.0128, found 237.1023.



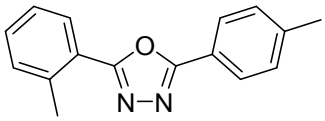
2-([1,1'-biphenyl]-4-yl)-5-phenyl-1,3,4-oxadiazole (6)

Obtained as white solid (120 mg, 40%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 160-162 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.20 (d, J = 8.4 Hz, 2H), 8.15-8.18 (m, 2H), 7.75 (d, J = 8.4 Hz, 2H), 7.64-7.67 (m, 2H), 7.54-7.57 (m, 3H), 7.47-7.5 (m, 2H), 7.39-7.43 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.5, 164.4, 144.3, 131.6, 129.0, 128.9, 127.6, 127.3, 127.1, 126.9, 123.8, 122.5. HRMS (*m/z*) (M+1) calcd for $C_{20}H_{14}N_2O$: 299.1179, found 299.1177.



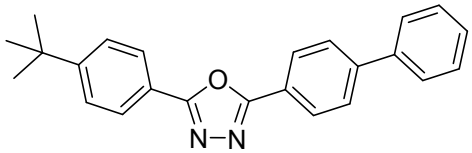
2-(4-(tert-butyl)phenyl)-5-phenyl-1,3,4-oxadiazole (7)

Obtained as white solid (146 mg, 52%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 82-84 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.14-8.16 (m, 2H), 8.05-8.08 (m, 2H), 7.52-7.57 (m, 5H), 1.37 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.8, 164.5, 155.4, 131.7, 129.2, 127.0, 126.9, 126.2, 124.1, 121.2, 35.3, 31.2. HRMS (*m/z*) (M+1) calcd for $C_{18}H_{18}N_2O$: 279.1492, found 279.1494.



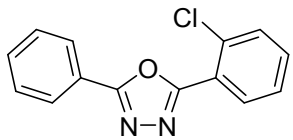
2-(o-tolyl)-5-(p-tolyl)-1,3,4-oxadiazole (8)

Obtained as white solid (100 mg, 40%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 96-98 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.00-8.04 (m, 3H), 7.40-7.44 (m, 1H), 7.32-7.36 (m, 4H) 2.77 (s, 3H), 2.43 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.7, 164.4, 142.3, 138.5, 131.9, 131.2, 129.9, 129.0, 127.0, 126.3, 123.2, 121.3, 22.3, 21.8. HRMS (*m/z*) (M+1) calcd for $C_{16}H_{14}N_2O$: 251.0128, found 251.1179.



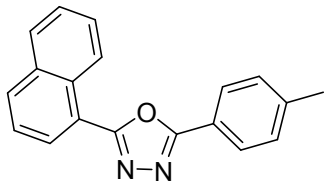
2-([1,1'-biphenyl]-4-yl)-5-(4-(tert-butyl)phenyl)-1,3,4-oxadiazole (9)

Obtained as white solid (167 mg, 47%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 123-125 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.20 (d, *J* = 8.4 Hz, 2H), 8.08 (d, *J* = 8.4 Hz, 2H), 7.75 (d, *J* = 8.4 Hz, 2H), 7.64-7.67 (m, 2H), 7.55 (d, *J* = 8.4 Hz, 2H), 7.46-7.50 (m, 2H) 7.39-7.42 (m, 1H), 1.42 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.8, 164.4, 155.5, 144.4, 139.9, 129.1, 128.3, 127.8, 127.5, 127.3, 126.9, 126.2, 122.9, 121.2, 35.2, 31.2. HRMS (*m/z*) (M+1) calcd for $C_{24}H_{22}N_2O$: 355.1805, found 355.1805.



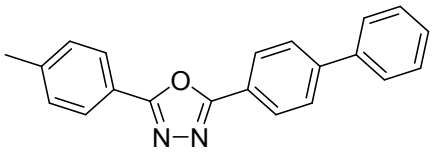
2-(2-chlorophenyl)-5-phenyl-1,3,4-oxadiazole (10)

Obtained as white solid (116 mg, 45%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 87-89 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.10-8.16 (m, 3H), 7.41-7.58 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 165.3, 163.2, 132.6, 132.0, 131.4, 129.4, 131.3, 129.2, 127.2, 127.1. HRMS (*m/z*) (M+1) calcd for $C_{14}H_9ClN_2O$: 257.0128, found 257.0475.



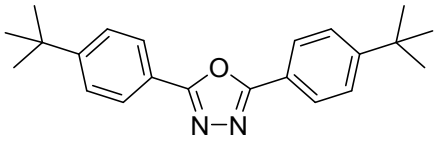
1-(4-(p-tolyl)cyclopenta-1,3-dien-1-yl)naphthalene (11)

Obtained as white solid (220 mg, 64%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 130-132 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 9.29-9.31 (d, *J* = 8.0 Hz, 1H), 8.24-8.29 (m, 2H), 8.05-8.11 (m, 3H), 7.94-7.96 (d, *J* = 8.0 Hz, 1H), 7.69-7.74 (m, 1H), 7.59-7.64 (m, 1H), 7.36-7.38 (d, *J* = 8.0 Hz, 2H), 2.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.4, 142.5, 132.6, 132.2, 129.9, 128.8, 128.4, 128.3, 127.1, 126.8, 126.4, 124.9, 121.2,120.7, 21.8. HRMS (*m/z*) (M+1) calcd for $C_{24}H_{22}N_2O$: 287.1140, found 287.1179.



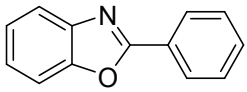
2-([1,1'-biphenyl]-4-yl)-5-(p-tolyl)-1,3,4-oxadiazole (12)

Obtained as white solid (147 mg, 47%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 149-151 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.19-8.21 (d, J = 8.4 Hz, 2H), 8.04-8.06(d, J = 8.4 Hz, 2H), 7.74-7.76 (d, J = 8.4 Hz, 2H), 7.65-7.67 (m, 2H), 7.47-7.51 (m, 2H), 7.39-7.41(m, 1H), 7.33-7.35 (d, J = 8.4 Hz,2H), 2.45 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.8, 164.3, 144.4, 142.4, 139.9, 129.9, 129.1, 128.3, 127.8, 127.4, 127.3, 127.0, 122.8, 121.2, 21.8. HRMS (*m/z*) (M+1) calcd for $C_{21}H_{16}N_2O$: 313.1179, found 313.1334.



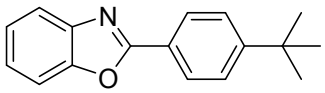
2,5-bis(4-(tert-butyl)phenyl)-1,3,4-oxadiazole (13)

Obtained as white solid (210 mg, 63%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp =140-142 °C; ^{1}H NMR (400 MHz, $(CD3)_2SO$) δ ppm 7.80-7.83 (d, J = 8.0 Hz, 4H), 7.39-7.40 (d, J = 8.0 Hz, 4H), 1.24 (s, 18H); ^{13}C NMR (100 MHz, $(CD3)_2SO$) δ ppm 153.7, 129.5, 125.0, 35.1, 31.6. HRMS (m/z) (M+1) calcd for $C_{24}H_{22}N_2O$: 335.2079, found 335.2118.



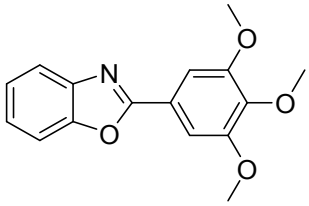
2-phenylbenzo[d]oxazole (14)

Obtained as white solid (123 mg, 63%) by chromatography on SiO_2 eluting with hexans/EtOAc (10:1, v/v); mp = 70-71 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.24-8.27 (m, 2H), 7.76-7.80 (m, 1H), 7.48-7.59 (m, 4H), 7.33-7.37 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 163.1, 150.8, 142.2, 131.6, 129.0, 127.7, 127.2, 125.2, 124.7, 120.1, 110.7. HRMS (*m/z*) (M+1) calcd for $C_{13}H_9NO$: 196.0757, found 196.0757.



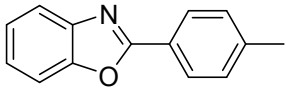
2-(4-(tert-butyl)phenyl)benzo[d]oxazole (15)

Obtained as white solid (196 mg, 78%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 95-97 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.18 (d, J = 8.0 Hz, 2H), 7.76-7.78 (m, 1H), 7.53-7.59 (m, 3H), 7.33-7.34 (m, 2H), 1.33 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 163.1, 150.8, 142.2,131.6, 129.0, 127.7, 127.2, 125.2, 124.7, 120.1, 110.7, 35.2, 31.2. HRMS (*m/z*) (M+1) calcd for $C_{17}H_{17}NO$: 252.0757, found 252.1347.



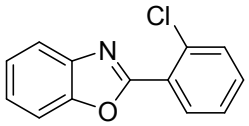
2-(3,4,5-trimethoxyphenyl)benzo[d]oxazole (16)

Obtained as white solid (183 mg, 64%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 105-107 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.24-8.27 (m, 2H), 7.76-7.80 (m, 1H), 7.48-7.59 (m, 4H), 7.33-7.37 (m, 2H), 4.00 (s, 3H), 3.99 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 163.1, 150.8, 142.2,131.6, 129.0, 127.7, 127.2, 125.2, 124.7, 120.1, 110.7, 56.2. HRMS (*m/z*) (M+1) calcd for $C_{16}H_{15}NO_4$: 286.0757, found 286.1047.



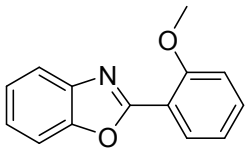
2-(p-tolyl)benzo[d]oxazole (17)

Obtained as white solid (140 mg, 67%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 102-105 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.24-8.27 (m, 2H), 7.76-7.80 (m, 1H), 7.48-7.59 (m, 4H), 7.33-7.37 (m, 2H), 2.24 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 163.1, 150.8, 142.2, 131.6, 129.0, 127.7, 127.2, 125.2, 124.7, 120.1, 110.7, 21.4. HRMS (*m/z*) (M+1) calcd for $C_{11}H_{14}NO$: 210.0757, found 210.0912.



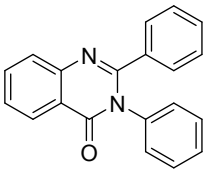
2-(2-chlorophenyl)benzo[d]oxazole (18)

Obtained as white solid (204 mg, 89%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 61-63 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.14- 8.16 (m, 1H), 7.83-7.88 (m, 1H), 7.60-7.63 (m, 1H), 7.56-7.58 (m, 1H), 7.38-7.46 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 163.1, 150.8, 142.2,131.6, 129.0, 127.7, 127.2, 125.2, 124.7, 120.1, 110.7. HRMS (*m/z*) (M+1) calcd for $C_{13}H_8ClNO$: 229.0294, found 230.0367.



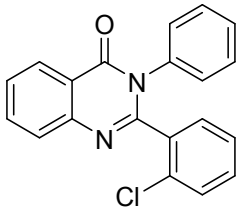
2-(2-methoxyphenyl)benzo[d]oxazole (19)

Obtained as white solid (142 mg, 63%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 71-73 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.24-8.27 (m, 2H), 7.76-7.80 (m, 1H), 7.48-7.59 (m, 4H), 7.33-7.37 (m, 2H), 3.99 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 163.1, 150.8, 142.2,131.6, 129.0, 127.7, 127.2, 125.2, 124.7, 120.1, 110.7, 56.2. HRMS (*m/z*) (M+1) calcd for $C_{14}H_{11}NO_2$: 226.0823, found 226.0863.



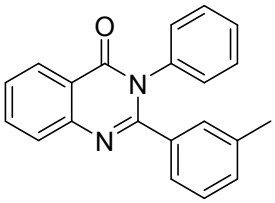
2,3-diphenylquinazolin-4(3*H*)-one (20)

Obtained as white solid (238 mg, 80%) by chromatography on SiO_2 eluting with hexane/EtOAc (10:1, v/v); mp = 71-73 °C; 1H NMR (400 MHz, CDCl3) δ ppm 8.35-8.37 (d, *J* = 8.0Hz, 1H), 7.79-7.85 (m, 2H), 7.52-7.59(m, 1H), 7.18-7.35(m, 8H), 7.14-7.16(m, 2H); HRMS (*m/z*) (M+1) calcd for C20H14N2O: 299.1140, found 299.1179.



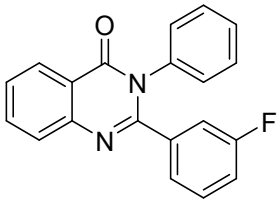
2-(2-chlorophenyl)-3-phenylquinazolin-4(3*H*)-one (21)

Obtained as white solid (266 mg, 80%) by chromatography on SiO_2 eluting with hexane/EtOAc (6:1, v/v); mp = 136-138 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.38-8.40 (d, *J* = 8.0 Hz, 1H), 7.83-7.87 (m, 2H), 7.55-7.59 (m, 1H), 7.40-7.42 (m, 1H), 7.01-7.30 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 162.1, 153.1, 147.3, 130.7, 129.6, 129.0, 127.9, 127.8, 127.3, 126.5. HRMS (*m/z*) (M+1) calcd for $C_{20}H_{13}N_2OCl$: 333.0789, found 333.0790.



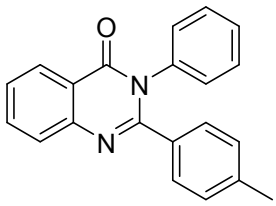
3-phenyl-2-(m-tolyl)quinazolin-4(3*H*)-one (22)

Obtained as white solid (256 mg, 82%) by chromatography on SiO_2 eluting with hexane/EtOAc (6:1, v/v); mp = 155-158 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.34-8.36 (dd, J_1 = 8.0 Hz, J_2 = 2.0 Hz, 2H), 7.74-7.88 (m, 2H), 7.50-7.54 (m, 1H), 7.25-7.33 (m, 3H), 7.22 (s, 1H), 7.14-7.16 (m, 2H), 7.04-7.05 (m, 3H), 2.24 (s, 3 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 162.4, 155.5, 147.5, 137.9, 137.8, 135.3, 134.8, 130.2, 129.7, 129.2, 129.0, 128.5, 127.9, 127.8, 127.3, 126.2, 121.0, 21.4. HRMS (*m/z*) (M+1) calcd for $C_{21}H_{16}N_2O$: 313.1335, found 313.1336.



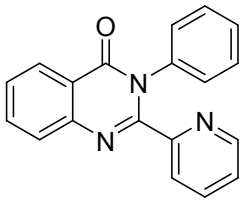
2-(3-fluorophenyl)-3-phenylquinazolin-4(3*H*)-one (23)

Obtained as white solid (246 mg, 78%) by chromatography on SiO_2 eluting with hexanes/EtOAc (6:1, v/v); mp = 171 - 174 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.34-8.36 (d, J = 8.0 Hz, 1H), 7.81-7.82 (m, 2H), 7.51-7.58 (m, 1H), 7.28-7.36 (m, 3H), 7.14-7.19 (m, 3H), 7.07-7.11 (m, 1H), 6.92-6.98 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 163.4, 162.2, 160.9, 153.9, 147.3, 137.4, 135.0, 129.8, 129.7, 129.3, 129.1, 128.8, 127.9, 127.7, 127.4, 125.0, 121.1, 116.7, 116.6, 116.5, 116.3. HRMS (*m/z*) (M+1) calcd for $C_{20}H_{13}N_2OF$: 317.1085, found 317.1093.



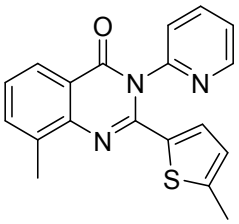
3-phenyl-2-(p-tolyl)quinazolin-4(3*H*)-one (24)

Obtained as white solid (203 mg, 85%) by chromatography on SiO_2 eluting with hexane/EtOAc (6:1, v/v); mp = 168-171 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.33-8.35 (d, J = 8.0 Hz, 2H), 7.78-7.81 (m, 2H), 7.50-7.53 (m, 1H), 7.27-7.31 (m, 3H), 7.21-7.23 (d, J = 8.0 Hz, 2H), 7.13-7.16 (m, 2H), 6.99-7.01 (d, J = 8.0 Hz, 2H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 162.5, 155.4, 147.7, 139.6, 137.9, 134.8, 132.7, 129.2, 129.1, 128.8, 128.5, 127.8, 127.2, 120.9, 27.0, 21.4. HRMS (*m/z*) (M+1) calcd for $C_{21}H_{16}N_2O$: 313.1335, found 313.1335.



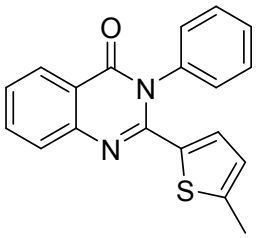
3-phenyl-2-(pyridin-2-yl)quinazolin-4(3*H*)-one (25)

Obtained as white solid (185 mg, 62%) by chromatography on SiO_2 eluting with hexane/EtOAc (6:1, v/v); ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.47 (s, 1H), 8.39- 8.40 (d, J = 8.0 Hz, 1H), 8.00-8.01 (d, J = 8.0 Hz, 1H), 7.85-7.88 (m, 1H), 7.71-7.75 (m, 1H), 7.59-7.63 (m, 1H), 7.28-7.34 (m, 4H), 7.22-7.24 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 162.1, 147.3, 137.5, 136.4, 134.9, 129.1, 128.9, 128.4, 128.1, 127.8, 127.4 . HRMS (*m/z*) (M+1) calcd for $C_{21}H_{16}N_2O$: 300.1092, found 300.1131.



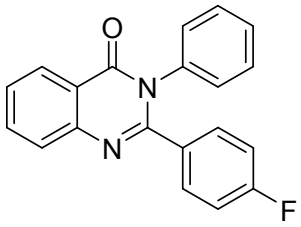
8-methyl-2-(5-methylthiophen-3-yl)-3-(pyridin-2-yl)quinazolin-4(3*H*)-one (26)

Obtained as white solid (233 mg, 70%) by chromatography on SiO_2 eluting with hexane/EtOAc (6:1, v/v); mp = 177-179 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.69-8.70 (dd, J_1 = 4.8 Hz, J_2 = 1.5 Hz, 1H), 8.10-8.12 (d, J = 8.0 Hz, 1H), 7.89-7.94 (m, 1H), 7.61 (d, J = 8.0 Hz, 1H), 7.44-7.49 (m, 2H), 7.31-7.35 (m, 1H) 6.42-6.43 (m, 1H), 5.88 (d, J = 4.0 Hz, 1H), 2.68 (s, 3H), 2.41 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 163.1, 151.6, 150.2, 146.5, 145.9, 138.9, 136.2, 136.1, 135.5, 130.3, 126.4, 126.2, 124.9, 124.8, 124.7, 120.3, 17.3, 15.5. HRMS (*m/z*) (M+1) calcd for $C_{18}H_{15}N_3OS$: 334.1009, found 334.1010.



2-(5-methylthiophen-2-yl)-3-phenylquinazolin-4(3*H*)-one (27)

Obtained as white solid (222 mg, 70%) by chromatography on SiO_2 eluting with hexans/EtOAc (6:1, v/v); mp = 180-182 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.26-8.28 (d, J = 8.0 Hz, 2H), 7.74-7.79 (m, 2H), 7.53-7.79 (m, 3H), 7.43-7.47 (m, 1H), 7.32-7.34 (m, 2H), 6.43-6.44 (d, J = 4.0 Hz, 2H), 6.07-6.08 (d, J = 4.0 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 162.7, 148.7, 147.9, 146.2, 137.9, 135.6, 134.8, 131.8, 129.9, 129.3, 127.4, 127.2, 126.7, 126.3, 120.3, 15.4. HRMS (*m/z*) (M+1) calcd for $C_{18}H_{15}N_3OS$: 319.0860, found 319.0900.



2-(4-fluorophenyl)-3-phenylquinazolin-4(3*H*)-one (28)

Obtained as white solid (189 mg, 60%) by chromatography on SiO_2 eluting with hexane/EtOAc (6:1, v/v); mp = 168-170 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm 8.35-8.36 (d, J = 8.0 Hz, 1H), 7.81-7.82 (d, J = 4.0 Hz, 2H), 7.53-7.57 (m, 1H), 7.29-7.36 (m, 5H), 7.14-7.16 (d, J = 8.0 Hz, 2H), 6.89-6.93 (t, J = 8.0 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm 164.3, 162.3, 161.8, 154.3, 147.4, 137.7, 134.9, 131.7, 131.3, 129.3, 129.2, 128.7, 127.8, 127.5, 127.3, 121.0, 115.4, 115.2. HRMS (*m/z*) (M+1) calcd for $C_{20}H_{13}FN_2O$: 317.1045, found 317.1086.

H. NMR Spectra

See files named “1H - NMR Spectra” and “13C - NMR Spectra”

I. HRMS Spectra

See files named “HRMS - Spectra”

References

[1] O.V. Dolomanov, L .J. Bourhis., , R. J. Gildea, J .A. K .Howard, H. Puschmann, J. Appl. Cryst., 2009,42, 339 - 341.

[2] G. M. Sheldrick, Acta Cryst., 2015, A71, 3 - 8.

[3] S. Guin, T. Ghosh, S. K. Rout, A. Banerjee, B. K. Patel, Org. Lett., 2011, 13(22): 5976-5979.