Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Information

For

Physical Organic Studies and Dynamic Covalent Chemistry of Picolyl Heterocyclic Amino Aminals

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General Considerations

Commercially available reagents were purchased and used without further purification unless otherwise indicated. $CDCl_3$, CD_3OD, CD_3CN, acetone-d_6 and DMSO-d_6 were simply dried over 3 Å molecular sieves. The NMR spectra were measured on 200, 400, and 600 MHz Agilent NMR spectrometers. The corresponding frequencies for ^{13}C NMR spectra were 50, 100 and 150 MHz, respectively. Chemical shifts are reported in δ (ppm), referenced to ^1H (residual) and ^{13}C signals of deuterated solvents as internal standards. UV-Vis absorption spectra were recorded on a SHIMADZU UV-2600 spectrophotometer. X-ray Single Crystal Diffraction spectra were recorded on Bruker and Oxford X-ray Single Crystal Diffractometer. HRMS was carried out on a Bruker micrOTOF II spectrometer using an ESI technique. Elemental analysis was done on a Thermo Scientific FLASH 2000 CHNS analyzer.

Synthesis and Spectral Characterization

Preparation of 3a. A methanol solution (20 mL) of 2-pyridinecarboxaldehyde (1.0738 g, 0.010 mol) was charged in a 50 mL round bottom flask equipped with a magnetic stir and added 2-aminopyridine (1.8903 g, 0.020 mol, 2.0 equiv). The mixture was stirred at room temperature for 18 h, giving a white precipitation. The resultant white powder was collected by filtration and washed with Et_2O for 3 times to give **3a** (2.1990 g, 79.1%). Anal. Calcd for $C_{16}H_{15}N_5$: C, 69.29; H, 5.45; N, 25.25. Found: C, 69.15; H, 5.43; N, 25.29. MS(ESI$^+$), *m/z* 184.145 $[(M\text{-}C_5H_6N_2)+H]^+$. ^1H NMR for **3a** (400 MHz, $CDCl_3$): δ 8.56 (d, $J_{H\text{-}H}$ = 3.20 Hz, 1H, *py*^{6}), 8.10 (d, $J_{H\text{-}H}$ = 3.20 Hz, 2H, *NH-py*^{6}), 7.64 (dd, $J_{H\text{-}H}$ = 6.80 Hz, 1H, *py*^{4}), 7.57 (d, $J_{H\text{-}H}$ = 8.00 Hz,1H, *py*^{3}), 7.41 (dd, $J_{H\text{-}H}$ = 6.80 Hz, 1H, *py*^{5}), 7.21 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *NH-py*^{4}), 6.84 (t, $J_{H\text{-}H}$ =6.80 Hz, 1H, *CH*), 6.59 (dd, $J_{H\text{-}H}$ =4.80 Hz, 2H, *NH-py*^{5}), 6.53 (d, $J_{H\text{-}H}$ = 8.40 Hz,2H, *NH-py*^{3}), 5.93 (d, $J_{H\text{-}H}$ = 7.60 Hz,2H, *NH*) ppm. ^{13}C NMR of **3a** (100 MHz, $CDCl_3$): δ 160.9, 157.5, 149.1, 148.2, 137.6, 137.2, 123.2, 122.1, 113.9, 108.5, 62.9 ppm. ^1H NMR for **4a** (400 MHz, $CDCl_3$): δ 9.17 (s, 1H, N=CH), 8.75 (d, $J_{H\text{-}H}$ = 4.0 Hz, 1H, *py*^{6}), 8.52 (d, $J_{H\text{-}H}$=4.0 Hz, 1H, N-*py*^{6}), 8.19 (d, $J_{H\text{-}H}$=8.0 Hz, 1H, N-*py*^{3}), 7.81 (dd, $J_{H\text{-}H}$=8.0, 8.0 Hz, 1H, *py*^{3}), 7.76 (dd, $J_{H\text{-}H}$=8.0, 8.0 Hz, 1H, N-*py*^{4}), 7.55 (dd, $J_{H\text{-}H}$=8.0, 8.0 Hz ,1H, *py*^{5}), 7.41 (m, 1H, N-*py*^{3}), 7.20 (m, 1H, N-*py*^{5}) ppm. ^{13}C NMR of **4a** (100 MHz, $CDCl_3$): δ 163.2, 158.8, 157.9, 150.2, 149.9, 138.4, 138.1, 136.6, 125.4, 121.7, 115.5 ppm.

Preparation of 3b. The synthesis was carried out in a similar manner as **3a**, using 2-pyridinecarboxaldehyde (1.3128 g, 0.012 mol) and 2-amino-6-methylpyridine (2.6530 g, 0.025 mol, 2.1 equiv) to give the white powder product **3b** (1.3580 g, 44.5%). Anal. Calcd for $C_{18}H_{19}N_5$: C, 70.80 H, 6.27; N, 22.93. Found: C, 70.76; H, 6.28; N, 23.06. MS(ESI$^+$), *m/z* 198.073 $[(M\text{-}C_6H_8N_2)+H]^+$ ^1H NMR for **3b** (400 MHz, $CDCl_3$): δ 8.56 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}), 7.65 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *py*^{4}), 7.57 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.29 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 2H, *Me-py*^{4}), 7.20 (dd, $J_{H\text{-}H}$ = 6.00 Hz,1H, *py*^{4}), 6.77 (t, $J_{H\text{-}H}$ =7.60 Hz, 1H, *CH*), 6.47 (dd, $J_{H\text{-}H}$ =7.20 Hz, 2H, *Me-py*^{5}), 6.39 (d, $J_{H\text{-}H}$ = 8.00 Hz, 2H, *Me-py*^{3}), 5.78 (d, $J_{H\text{-}H}$ = 7.60 Hz, 2H, *NH*), 2.37 (s, 6H, *Me-py*) ppm. ^{13}C NMR of **3b** (100 MHz, $CDCl_3$): δ 160.6, 157.5, 157.0, 149.0, 137.9, 137.0, 123.1, 122.9, 122.1, 104.9, 63.3, 24.5 ppm. ^1H

NMR for **4b** (400 MHz, $CDCl_3$): δ 9.08 (s, 1H, N=C*H*), 8.73 (d, J_{H-H}=4.5 Hz, 1H, *py*^{6}), 8.23 (d, J_{H-H}=7.9 Hz, 1H, *py*^{3}), 7.80 (dd, J_{H-H}=7.6, 12.1 Hz, 1H, *py*^{4}), 7.37 (dd, J_{H-H}=7.9, 8.0 Hz ,1H, *py*^{5}), 7.14 (d, J_{H-H}=7.6 Hz ,1H, Me-*py*^{3}), 7.07 (d, J_{H-H}=7.6 Hz ,1H, Me-*py*^{5}), 2.57 (s, 3H, *Me*-py) ppm. ^{13}C NMR of **4b** (100 MHz, $CDCl_3$): δ 163.2, 158.8, 157.9, 150.2, 149.9, 138.4, 138.1, 136.6, 125.4, 121.7, 115.5 ppm.

Preparation of 3c. The synthesis was carried out in a similar manner as **3a**, using 2-pyridinecarboxaldehyde (1.0744 g, 0.010 mol) and 2-amino-pyrimidine (1.9054 g, 0.020 mol, 2.0 equiv) to give the white powder product **3c** (2.2232 g, 79.4%). Anal. Calcd for $C_{14}H_{13}N_7$: C, 60.20; H, 4.69; N, 35.10. Found: C, 60.16; H, 4.73; N, 35.37. MS(ESI$^+$), *m/z* 280.26 $[M+H]^+$, 185.08 $[(M-C_4H_5N_3)+H]^+$. ^{1}H NMR for **3c** (400 MHz, $CDCl_3$): δ 8.59 (d, J_{H-H} = 4.00 Hz, 1H, *py*^{6}), 8.32 (d, J_{H-H} = 6.00 Hz, 4H, *pym*^{4,6}), 7.65 (m, 2H, *py*^{3,4}), 7.27 (dd, 1H, *py*^{5}), 7.12 (t, J_{H-H}=8.00 Hz, 1H, *CH*), 6.59 (m, 4H, *pym*^{5}, *NH*) ppm. ^{13}C NMR of **3c** (100 MHz, $CDCl_3$): δ 161.6, 158.4, 158.2, 149.2, 137.0, 123.1, 121.9, 111.7, 62.2 ppm.

Preparation of 3d. The synthesis was carried out in a similar manner as **3a**, using 2-pyridinecarboxaldehyde (1.0744 g, 0.010 mol) and 2-amino-4,6-dimethylpyrimidine (2.4630 g, 0.020 mol, 2.0 equiv) to give the white powder product **3d** (1.4322 g, 42.7%). Anal. Calcd for $C_{18}H_{21}N_7$: C, 64.46; H, 6.31; N, 29.23. Found: C, 64.20; H, 6.25; N, 29.36. MS(ESI$^+$), *m/z* 336.27 $[M+H]^+$, 213.015 $[(M-C_6H_9N_3)+H]^+$. ^{1}H NMR for **3d** (400 MHz, $CDCl_3$): δ 8.51 (d, J_{H-H}=4.0 Hz 1H, *py*^{6}), 7.75 (dd, J_{H-H}=6.9, 7.0 Hz, 1H, *py*^{4}), 7.55 (d, J_{H-H}=7.1 Hz, 1H, *py*^{3}), 7.25 (d, J_{H-H}=7.8 Hz, 2H, N*H*), 7.08 (dd, J_{H-H}=8.2 Hz, 1H, *py*^{5}), 6.41(s, 2H, *pym*^{5}), 6.33 (d, J_{H-H}=11.28 Hz, 1H, C*H*), 2.17 (s, 12H, pym-*Me*) ppm. ^{13}C NMR of **3c** (100 MHz, $CDCl_3$): δ 167.4, 161.6, 159.1, 148.8, 136.6, 122.6, 121.9, 110.6, 62.5, 24.0 ppm.

Preparation of 3e. The synthesis was carried out in a similar manner as **3a**, using 2-pyridinecarboxaldehyde (532 g, 4.972 mmol) and 2-methoxy-5nitroaniline (1.681 g, 9.997 mmol, 2.0 equiv) to give the yellow powder product **3e** (3.6754 g, 86.4%). Anal. Calcd for $C_{20}H_{19}N_5O_6$: C, 56.47 H, 4.50; N, 16.46. Found: C, 56.23; H, 4.55; N, 16.74. MS(ESI$^+$), *m/z* 426.332 $[M+H]^+$, 258.167 $[(M-C_7H_8N_2O_3)+H]^+$ ^{1}H NMR for **3e** (400 MHz, $CDCl_3$): δ 8.70 (d, J_{H-H} = 4.40 Hz, 1H, *py*^{6}), 7.74 (dd, J_{H-H} = 7.20, 1.20 Hz, 1H, *py*^{4}), 7.69 (d, J_{H-H} = 2.40 Hz, 2H, *Ar*^{4}), 7.56-7.53 (m, 3H, py^3, *Ar*^{6}), 7.31 (dd, J_{H-H}=4.80, 3.60 Hz, 1H, *py*^{4}), 6.79 (d, J_{H-H}=8.80 Hz, 2H, *Ar*^{3}), 5.99 (t, J_{H-H}=6.40 Hz, 1H, *CH*), 5.80 (d, J_{H-H}=6.00 Hz, 2H, *NH*), 3.94 (s, 6H, -*OMe*) ppm. ^{13}C NMR of **3e** (100 MHz, $CDCl_3$): δ 157.5, 152.3, 149.8, 141.7, 141.1, 136.8, 123.9, 121.8, 115.0, 109.1, 106.2, 67.2, 56.3 ppm. ^{1}H NMR for **4e** (400 MHz, $CDCl_3$): δ 8.74 (d, J_{H-H} = 4.40 Hz, 1H, *py*^{6}), 8.65 (s, 1H, N=CH), 8.23 (d, J_{H-H} = 8.00 Hz, 1H, *py*^{3}), 8.17 (d, J_{H-H} = 2.80 Hz, 1H, *Ar*^{4}), 7.98 (d, J_{H-H} = 2.80 Hz, 1H, *Ar*^{6}), 7.84 (dd, J_{H-H}=7.60 Hz, 1H, *py*^{4}), 7.42 (dd, J_{H-H}=4.80, 1.20 Hz, 1H, *py*^{5}), 7.02 (d, J_{H-H}=9.20 Hz, 1H, *Ar*^{3}), 3.99 (s, 3H, -*OMe*) ppm. ^{13}C NMR of **4e** (100 MHz, $CDCl_3$): δ 164.3, 157.4, 154.1, 150.0, 142.2, 137.6, 137.0, 135.8, 125.9, 123.3, 122.4, 116.3, 56.7 ppm.

Preparation of 6c. To an acetonitrile solution (20 mL) of **3c** (1.3959 g, 4.99 mmol) equipped with a magnetic stir was added $NaBH_4$ (189.9 mg, 5.02 mol, 1.0 equiv). The mixture was brought to reflux temperature and stirred for 1 h. After the solution has cooled down to room temperature, the solvent was removed by rotary evaporation to give pale yellow oil. The oily product was then extracted with with H_2O/CH_2Cl_2 (3 × 20 mL), and the combined organics were dried over $MgSO_4$. After filtering off the salt, the volatiles were removed by rotary evaporation. The resultant powder was washed with hexane for 3 times to yield **6c** (308 mg, 33.2%). ^{1}H NMR of **6c** (400 MHz, $CDCl_3$): δ 8.57 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 8.31 (d, $J_{H\text{-}H}$ = 4.00 Hz, 2H, *pym*^{4,6}), 7.64 (dd, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{4}), 7.31 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{2}), 7.18 (dd, $J_{H\text{-}H}$ =8.00 Hz, 1H, *py*^{3}), 6.55 (t, $J_{H\text{-}H}$ =4.00 Hz, 1H, *pym*^{5}), 4.75 (s, 1H, *CH*) ppm. ^{13}C NMR of **6c** (100 MHz, $CDCl_3$): δ 162.3, 158.3, 157.9, 149.3, 136.7, 122.3, 121.7, 111.0, 46.6 ppm. HRMS (ESI, *m*/*z*): calcd for $[C_{10}H_{11}N_4]^+$ 187.0984, found: 187.0985.

Formation of hemiaminal ether 5a. A NMR tube equipped was charged with a CD_3OD solution (0.5 mL) of **3a** (12.0 mg, 0.043 mmol) and followed by ^{1}H NMR spectroscopy. After 7 days, **3a** was totally converted to **5a**. Removing CD_3OD and re-dissolving the powder into $CDCl_3$, the ^{1}H NMR spectrum shows the same results as that of measuring **3a** in $CDCl_3$. ^{1}H NMR of **5a** (400 MHz, CD_3OD): δ 8.55 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 8.04 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *NH-py*^{6}), 7.87 (dd, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{4}), 7.64 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.53 (dd, $J_{H\text{-}H}$=8.00 Hz, 1H, *NH-py*^{4}), 7.40 (dd, $J_{H\text{-}H}$=8.00 Hz, 1H, *py*^{5}), 6.75 (d, $J_{H\text{-}H}$=8.00 Hz, 1H, *NH-py*^{3}), 6.71 (dd, $J_{H\text{-}H}$=6.00 Hz, 1H, *NH-py*^{5}),6.20 (s, 1H, *CH*) ppm. ^{13}C NMR of **5a** (100 MHz, CD_3OD): δ 160.8, 158.8, 148.3, 147.8, 139.4, 139.2, 125.0, 123.2, 114.0, 110.4, 85.0 ppm.

Formation of hemiaminal ether 5b. A NMR tube equipped was charged with a CD_3OD solution (0.5 mL) of **3b** (13.0 mg, 0.042 mmol) and followed by ^{1}H NMR spectroscopy. After 3 days, **3b** was totally converted to **5b**. Removing CD_3OD and re-dissolving the powder into $CDCl_3$, the ^{1}H NMR spectrum shows the same results as that of measuring **3b** in $CDCl_3$. ^{1}H NMR of **5b** (400 MHz, CD_3OD): δ 8.56 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 7.89 (dd, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{4}), 7.63 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.42 (dd, $J_{H\text{-}H}$ = 8.00 Hz, 1H, Me-*py*^{4}), 7.33 (dd, $J_{H\text{-}H}$=8.00 Hz, 1H, *py*^{5}), 6.58 (d, $J_{H\text{-}H}$=8.00 Hz, 1H, Me-*py*^{5}), 6.37 (d, $J_{H\text{-}H}$=8.00 Hz, 1H, Me-*py*^{3}), 6.16 (s, 1H, *CH*), 2.37 (s, 3H, Me-*py*) ppm. ^{13}C NMR of **5b** (100 MHz, CD_3OD): δ 160.4, 158.5, 157.7, 149.8, 139.8, 139.6, 125.0, 123.3, 114.7, 107.2, 85.2, 24.0 ppm.

Formation of hemiaminal ether 5c. A NMR tube equipped was charged with a CD_3OD solution (0.5 mL) of **3c** (12.0 mg, 0.043 mmol) and followed by ^{1}H NMR spectroscopy. After 20 days, **3c** was totally converted to **5c**. Removing CD_3OD and re-dissolving the powder into $CDCl_3$, only the signals of **5c** can be detected in the ^{1}H NMR spectum. ^{1}H NMR of **5c** (400 MHz, CD_3OD): δ 8.55 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 8.37 (d, $J_{H\text{-}H}$ = 4.80 Hz, 2H, *pym*^{4,6}), 7.89 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *py*^{4}), 7.65 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.39 (dd, $J_{H\text{-}H}$=4.80 Hz, 1H, *py*^{5}), 6.76 (t, $J_{H\text{-}H}$=4.80 Hz, 1H, *pym*^{5}), 6.40 (s, 1H, *CH*) ppm.

^{13}C NMR of **5c** (100 MHz, CD_3OD): δ 160.2, 159.5, 158.8, 149.8, 138.9, 125.0, 123.1, 111.8, 84.8 ppm.

Formation of hemiaminal ether 5d. A NMR tube equipped was charged with a CD_3OD solution (0.5 mL) of **3d** (14.0 mg, 0.042 mmol) and followed by ^{1}H NMR spectroscopy. After 3 days, **3d** was totally converted to **5d**. Removing CD_3OD and re-dissolving the powder into $CDCl_3$, only the signals of **5d** can be detected in the ^{1}H NMR spectum. ^{1}H NMR of **5d** (400 MHz, CD_3OD): δ 8.55 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}), 7.87 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *py*^{4}), 7.89 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *py*^{4}), 7.62 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.38 (dd, $J_{H\text{-}H}$=4.80 Hz, 1H, *py*^{5}), 6.56 (s, 1H, *CH*), 6.47 (s, 2H, *NH*, *pym*^{5}), 2.32 (s, 6H, *pym-Me*) ppm. ^{13}C NMR of **5c** (100 MHz, CD_3OD): δ 169.5, 162.8, 158.8, 149.8, 138.9, 125.0, 123.1, 110.9, 84.6, 23.4 ppm.

Formation of hemiaminal ether 5e. A NMR tube equipped was charged with a CD_3OD solution (0.5 mL) of **3e** (15.0 mg, 0.035 mmol) and followed by ^{1}H NMR spectroscopy. After 1 day, **3e** was totally converted to **5e**. ^{1}H NMR of **5e** (400 MHz, CD_3OD): δ 8.61 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}), 7.91 (dd, $J_{H\text{-}H}$ = 8.00, 1.60 Hz, 1H, *py*^{4}), 7.77 (d, $J_{H\text{-}H}$ = 2.80 Hz, 1H, *py*^{3}), 7.69 (d, $J_{H\text{-}H}$ = 2.40 Hz, 1H, *Ar*^{4}), 7.56 (d, $J_{H\text{-}H}$=3.60 Hz, 1H, *Ar*^{6}), 7.41 (dd, $J_{H\text{-}H}$=4.80, 1.20 Hz, 1H, *py*^{5}), 7.01 (d, $J_{H\text{-}H}$=8.80 Hz, 1H, *Ar*^{3}), 6.93 (d, $J_{H\text{-}H}$=8.80 Hz, 1H, *Ar*^{3}), 5.88 (s, 1H, CH), 4.01 (s, 3H, -*OMe*) ppm. ^{13}C NMR of **5e** (100 MHz, CD_3OD): δ 157.6, 149.9, 138.8, 125.2, 123.7, 115.7, 114.7, 110.2, 110.0, 109.3, 107.3, 85.9, 56.6 ppm.

Theoretical Calculation

The energies, optimal geometries and the NBO analysis for the solvent molecule-**4c** dimers were computed by the Gaussian 16 program package. Since the assessment is concentrated on the non-covalent interaction, the highly parameterized, empirical exchange-correlation global hybrid functional M06-2X and the def2TZVP basis set was chosen as the calculation level. We also applied the Grimme's D3 empirical correction and the polarizable continuum model (PCM) to include the dispersion energy missing and the bulk solvent effect, respectively. All positive frequencies confirmed all the optimal structures are at the local minima. The intermolecular forces of n→π* and π→π* were evaluated by the 2nd perturbation energy obtained from the NBO analysis.

X-ray crystallographic analysis

Table S1 Crystal data and structure refinements for **3a, 3c** and **3e**

	3a	**3c**	**3e**
Formula	$C_{16}H_{16}N_5$	$C_{14}H_{13}N_7$	$C_{20}H_{19}N_5O_6$
Crystal system	Orthorhombic	Monoclinic	Triclinic
Space group	Pbcn	$P2_1/n$	P-1
Unit cell dimensions	*a*=16.8760 (3) Å, α=90° *b*=8.68900 (10) Å, β=90° *c*=19.6210 (4) Å, γ=90°	*a*=9.5910 (2) Å, α=90° *b*=9.3160 (2) Å, β=97.514(10)° *c*=15.9820 (3) Å, γ=90°	*a*=9.4919 (13) Å, α=116.493(3)° *b*=11.0881 (15) Å, β=93.798(4)° *c*=11.4018(14) Å, γ=107.669(4)°
Z	8	4	2
Final *R* indices [i>2 sigma(i)]	R_{obs}=0.0578, wR_{obs}=0.1471	R_{obs}=0.0497, wR_{obs}=0.1254	R_{obs}=0.0430, wR_{obs}=0.0984
R indices (all data)	R_{all}=0.0890, wR_{all}=0.1778	R_{all}=0.0960, wR_{all}=0.1565	R_{all}=0.0720, wR_{all}=0.1227

Table S2 Crystal data and structure refinements for **6c**

	6c
Formula	$C_{10}H_{10}N_4$
Crystal system	Monoclinic
Space group	C2/c
Unit cell dimensions	*a*=16.8629 (17) Å, α=90° *b*=7.7228 (7) Å, β=104.655(3)° *c*=14.8431 (14) Å, γ=90°
Z	8
Final *R* indices [i>2 sigma(i)]	R_{obs}=0.0352, wR_{obs}=0.0844
R indices (all data)	R_{all}=0.0422, wR_{all}=0.0901

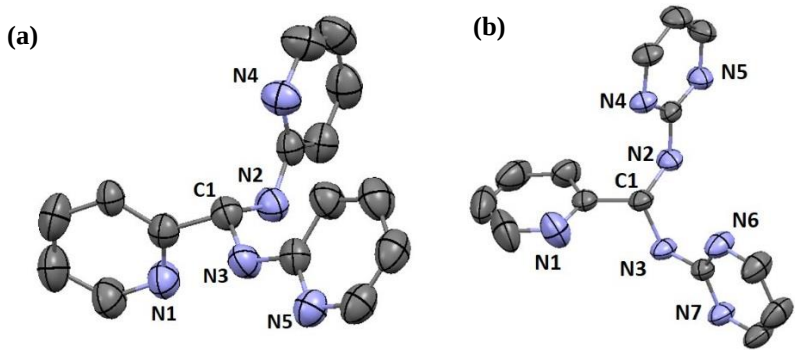

Figure S1: ORTEP plots of (a) **3a** (space group: Pbcn) and (b) **3c** (space group: P21/n) with 50% probability thermal ellipsoids. Hydrogen atoms are omitted for clarity. Selected distances (Å) and angles (deg) for (a): C1-N2 1.452(2), C1-N3 1.444(2), N2-C1-N3 112.30(14); (b) C1-N2 1.448(2), C1-N3 1.446(2), N2-C1-N3 109.43(15).

Responsiveness of aminals to the solvent stimulus

(a) NMR Spectra

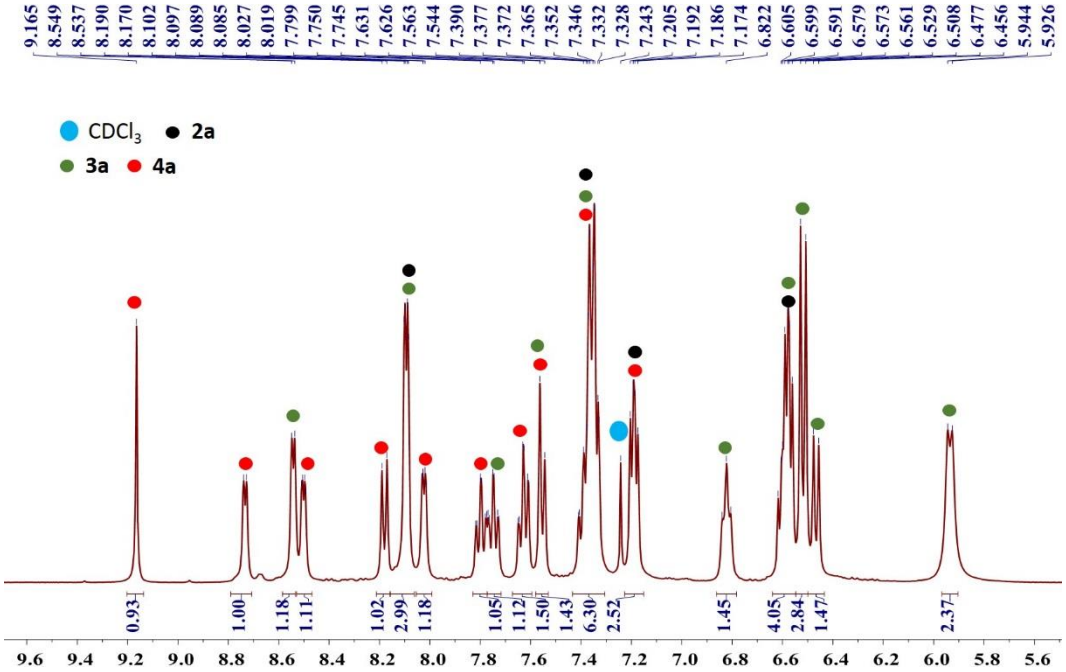

Figure S2: ^{1}H NMR spectrum for the equilibrium of **3a/4a** in $CDCl_3$ at 301 K. ^{1}H NMR of **3a** (400 MHz, $CDCl_3$): δ8.56 (d, $J_{H\text{-}H}$ = 3.20 Hz, 1H, *py*^{6}), 8.10 (d, $J_{H\text{-}H}$ = 3.20 Hz, 2H, *NH-py*^{6}), 7.64 (dd, $J_{H\text{-}H}$ = 6.80 Hz, 1H, *py*^{4}), 7.57 (d, $J_{H\text{-}H}$ = 8.00 Hz,1H, *py*^{3}), 7.41 (dd, $J_{H\text{-}H}$ = 6.80 Hz, 1H, *py*^{5}), 7.21 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *NH-py*^{4}), 6.84 (t, $J_{H\text{-}H}$ =6.80 Hz, 1H, *CH*), 6.59 (dd, $J_{H\text{-}H}$ =4.80 Hz, 2H, *NH-py*^{5}), 6.53 (d, $J_{H\text{-}H}$ = 8.40 Hz,2H, *NH-py*^{3}), 7.57 (d, $J_{H\text{-}H}$ = 7.60 Hz,2H, *NH*) ppm. ^{1}H NMR of **4a** (400 MHz, $CDCl_3$): δ9.18 (s, 1H, *C=N*), 8.75 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}),8.20 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 8.04 (d, $J_{H\text{-}H}$ = 4.80 Hz,1H, *NH-py*^{6}), 7.82 (dd, $J_{H\text{-}H}$ = 7.60, 1.60 Hz, 1H, NH-*py*^{4}), 7.41 (dd, 3H, *py*^{4}, *py*^{5}, *NH-py*^{5}), 7.36 (d, $J_{H\text{-}H}$ =8.00 Hz, 1H, NH-*py*^{3}) ppm.

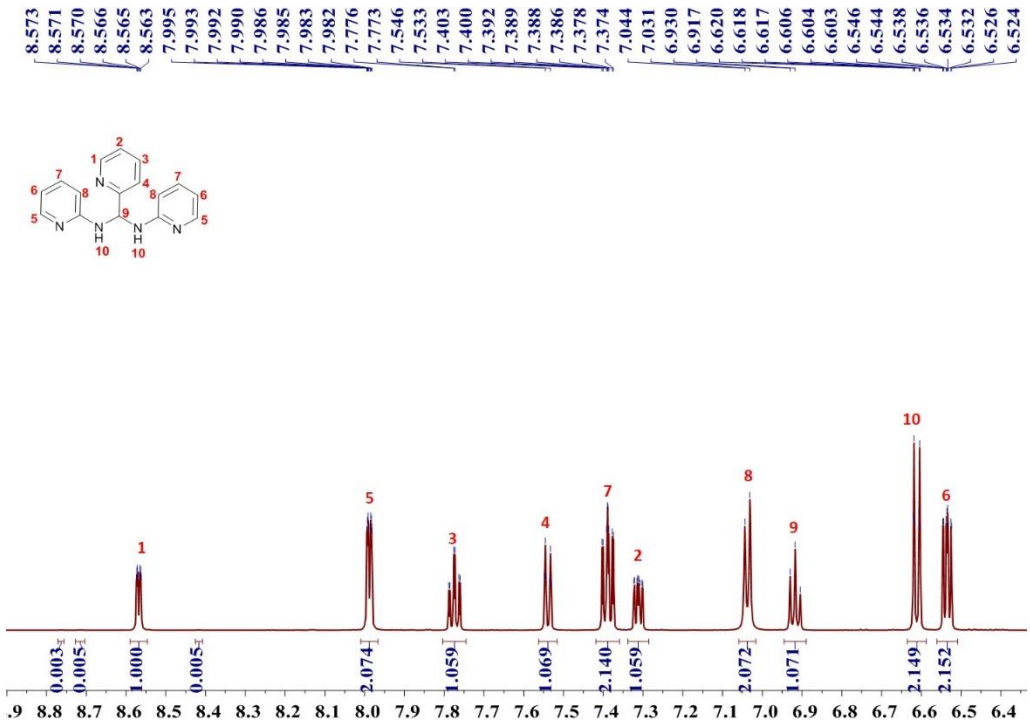

Figure S3: ^{1}H NMR spectrum of **3a** in DMSO-d_6 at 301 K. ^{1}H NMR of **3a** (400 MHz, DMSO-d_6): δ 8.57 (d, $J_{H\text{-}H}$ = 2.40 Hz, 1H, *py*^{6}), 7.98 (d, $J_{H\text{-}H}$ = 2.80 Hz, 2H, *NH-py*^{6}), 7.77 (dd, $J_{H\text{-}H}$ = 1.20 Hz,1H, *py*^{4}), 7.53 (d, $J_{H\text{-}H}$ = 5.20 Hz, 1H, *py*^{3}), 7.38 (dd, $J_{H\text{-}H}$ = 1.20 Hz, 2H, *NH-py*^{4}), 7.31 (dd, $J_{H\text{-}H}$ =3.20 Hz, 1H, *py*^{5}), 7.04 (d, $J_{H\text{-}H}$ =5.20 Hz, 2H, *NH-py*^{3}), 6.91 (t, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *CH*), 6.60 (d, $J_{H\text{-}H}$ = 5.60 Hz,2H, *NH*), 6.53 (dd, $J_{H\text{-}H}$ = 3.20 Hz, 2H, *NH-py*^{5}) ppm.

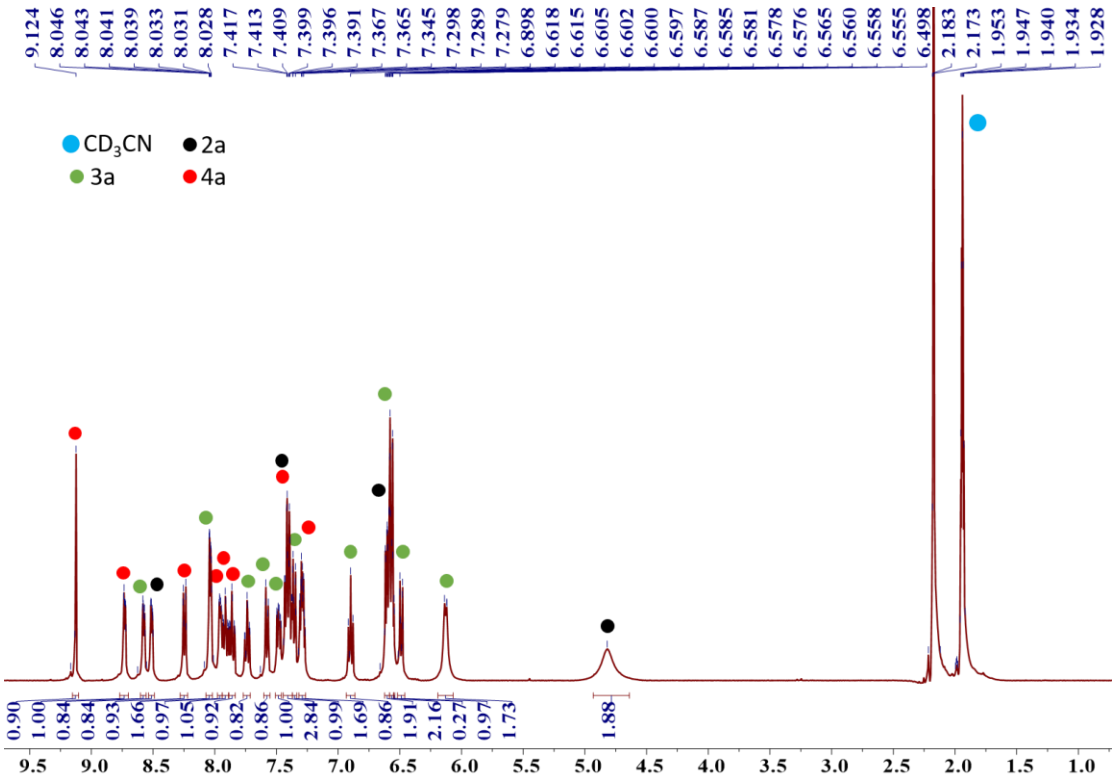

Figure S4: ^{1}H NMR spectrum for the equilibrium of **3a**/**4a** in CD_3CN at 301 K. ^{1}H NMR of **3a** (400 MHz, CD_3CN): δ 8.57 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}), 8.03 (d, $J_{H\text{-}H}$ = 4.80 Hz, 2H, *NH-py*^{6}), 7.73 (dd, $J_{H\text{-}H}$ = 8.00 Hz,1H, *py*^{4}), 7.57 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.48 (dd, $J_{H\text{-}H}$ =5.20 Hz, 1H, *py*^{5}), 7.28 (dd, $J_{H\text{-}H}$ = 3.60 Hz, 2H, *NH-py*^{4}), 6.89 (t, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *CH*), 6.56 (d, $J_{H\text{-}H}$ =8.00 Hz, 2H, *NH-py*^{3}), 6.60 (dd, $J_{H\text{-}H}$ = 4.80 Hz, 2H, *NH-py*^{5}), 6.12 (d, $J_{H\text{-}H}$ = 7.20 Hz,2H, *NH*) ppm. ^{1}H NMR of **4a** (400 MHz, CD_3CN): δ 9.12 (s, 1H, *C=N*), 8.72 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}),8.24 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.96 (d, $J_{H\text{-}H}$ = 4.80 Hz,1H, *NH-py*^{6}), 7.91 (dd, $J_{H\text{-}H}$ = 7.60, 1.60 Hz, 1H, NH-*py*^{4}), 7.86 (dd, $J_{H\text{-}H}$ = 8.00, 2.00 Hz, 1H, *py*^{4}), 7.41 (dd, 2H, *py*^{5}, *NH-py*^{5}), 7.35 (d, $J_{H\text{-}H}$ =8.00 Hz, 1H, NH-*py*^{3}) ppm.

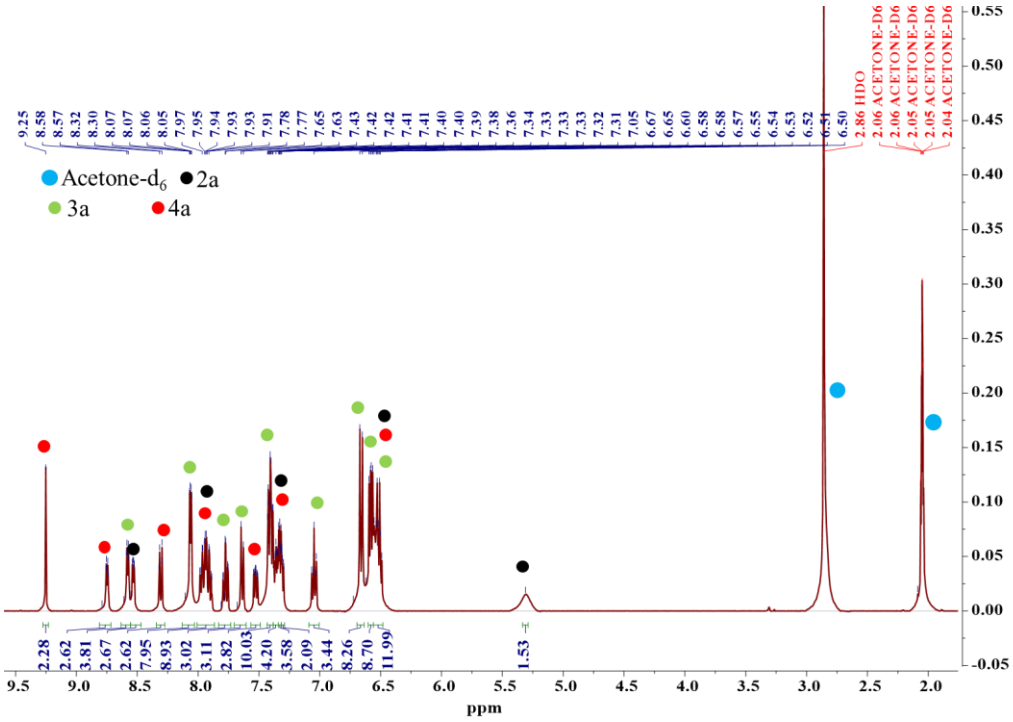

Figure S5: ^{1}H NMR spectrum for the equilibrium of **3a**/**4a** in acetone-d_6 at 301 K. ^{1}H NMR of **3a** (400 MHz, acetone-d_6): δ 8.57 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}), 8.05 (d, $J_{H\text{-}H}$ = 4.80 Hz, 2H, *NH-py*^{6}), 7.76 (dd, $J_{H\text{-}H}$ = 8.00 Hz,1H, *py*^{4}), 7.63 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.40 (dd, $J_{H\text{-}H}$ = 3.60 Hz, 2H, *NH-py*^{4}), 7.31 (dd, $J_{H\text{-}H}$ =5.20 Hz, 1H, *py*^{5}), 7.04 (t, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *CH*), 6.65 (d, $J_{H\text{-}H}$ =8.00 Hz, 2H, *NH-py*^{3}), 6.57 (dd, $J_{H\text{-}H}$ = 4.80 Hz, 2H, *NH-py*^{5}), 6.55 (d, $J_{H\text{-}H}$ = 7.20 Hz,2H, *NH*) ppm. ^{1}H NMR of **4a** (400 MHz, acetone-d_6): δ 9.25 (s, 1H, *C=N*), 8.74 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}),8.30 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.95 (d, $J_{H\text{-}H}$ = 4.80 Hz,2H, *NH-py*^{6}, *NH-py*^{4}), 7.90 (dd, 2H, *py*^{5}, *NH-py*^{5}), 7.52 (dd, $J_{H\text{-}H}$ = 8.00, 2.00 Hz, 1H, *py*^{4}), 7.34 (d, $J_{H\text{-}H}$ =8.00 Hz, 1H, NH-*py*^{3}) ppm.

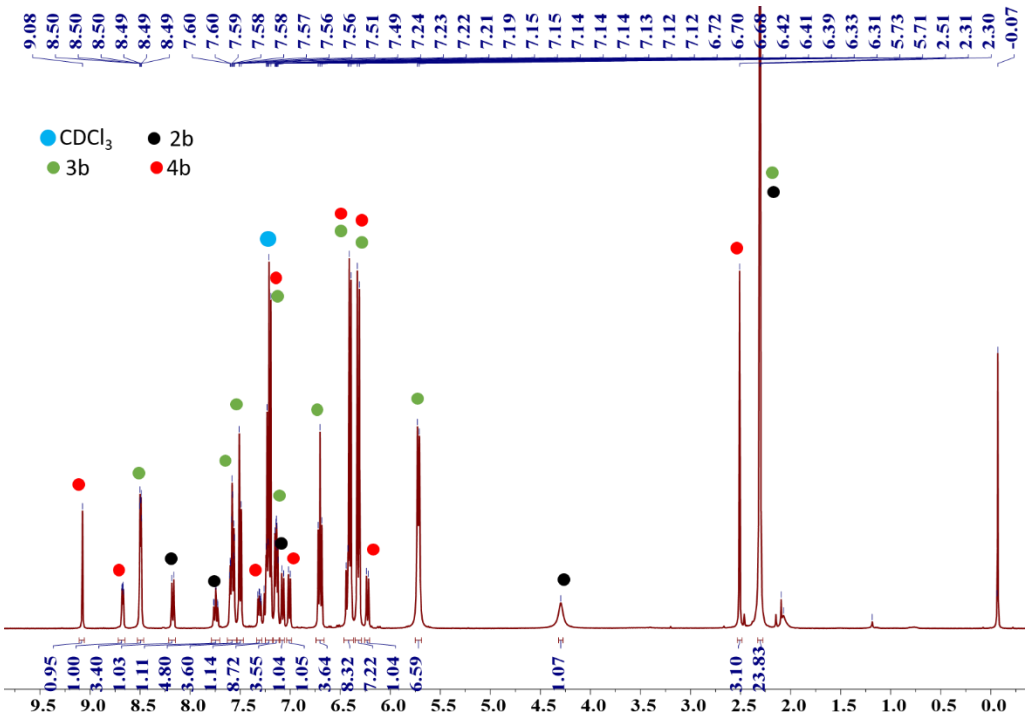

Figure S6: ^{1}H NMR spectrum for the equilibrium of **3b**/**4b** in $CDCl_3$ at 301 K. ^{1}H NMR of **3b** (400 MHz, $CDCl_3$): δ8.56 (d, $J_{H\text{-}H}$ = 4.80 Hz, 1H, *py*^{6}), 7.65 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *py*^{4}), 7.57 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.29 (dd, $J_{H\text{-}H}$ = 7.60 Hz, 2H, *Me-py*^{4}), 7.20 (dd, $J_{H\text{-}H}$ = 6.00 Hz,1H, *py*^{4}), 6.77 (t, $J_{H\text{-}H}$ =7.60 Hz, 1H, *CH*), 6.47 (dd, $J_{H\text{-}H}$ =7.20 Hz, 2H, *Me-py*^{5}), 6.39 (d, $J_{H\text{-}H}$ = 8.00 Hz, 2H, *Me-py*^{3}), 5.78 (d, $J_{H\text{-}H}$ = 7.60 Hz, 2H, *NH*), 2.37 (s, 6H, *Me-py*) ppm. ^{1}H NMR of **4b** (400 MHz, $CDCl_3$): δ9.08 (s, 1H, *C=N*), 8.67 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 7.74 (dd, $J_{H\text{-}H}$ = 7.60, 1.20 Hz ,1H, *py*^{4}), 7.31 (dd, $J_{H\text{-}H}$ = 4.80, 1.20 Hz, 1H, *py*^{5}), 7.14 (dd, 3H, py^{3}, *Me-py*^{4}, *Me-py*^{5}), 6.43 (d, $J_{H\text{-}H}$ = 7.20 Hz, 1H, *Me-py*^{3}), 2.51 (s, 3H, *Me-py*) ppm.

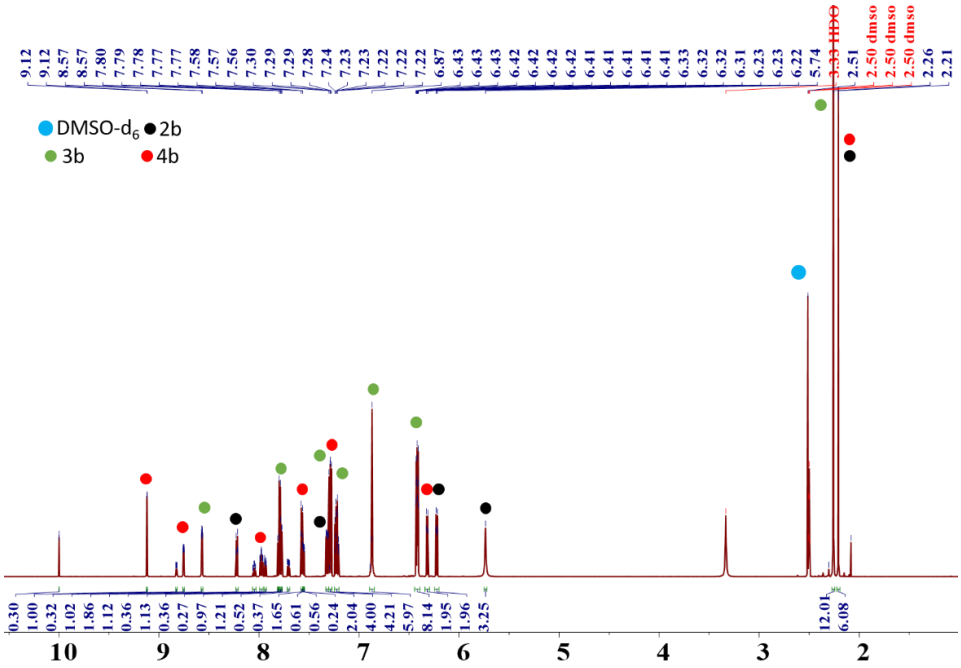

Figure S7: ^{1}H NMR spectrum for the equilibrium of **3b/4b** in DMSO-d_6 at 301 K. ^{1}H NMR of **3b** (400 MHz, DMSO-d_6): δ 8.56 (d, $J_{H\text{-}H}$ = 2.40 Hz, 1H, *py*^{6}), 7.78 (d, $J_{H\text{-}H}$ = 1.60 Hz, 1H, *py*^{3}), 7.56 (dd, 1H, *py*^{4}), 7.28 (dd, $J_{H\text{-}H}$ = 4.80 Hz, 2H, *Me-py*^{4}), 7.23 (dd, $J_{H\text{-}H}$ = 0.80 Hz, 1H, *py*^{5}), 6.87 (br, 2H, *NH*), 6.42 (m, 4H, *Me-py*^{3,5}), 5.73 (s, 1H, *CH*), 2.27 (s, 6H, *Me-py*) ppm. ^{1}H NMR of **4b** (400 MHz, DMSO-d_6): δ9.12 (s, 1H, *C=N*), 8.75 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 7.98 (dd, $J_{H\text{-}H}$ = 7.60, 1.20 Hz ,1H, *py*^{4}), 7.56 (dd, $J_{H\text{-}H}$ = 4.80, 1.20 Hz, 1H, *py*^{5}), 7.30 (dd, 3H, py^{3}, *Me-py*^{4}, *Me-py*^{5}), 6.32 (d, $J_{H\text{-}H}$ = 7.20 Hz, 1H, *Me-py*^{3}), 2.21 (s, 3H, *Me-py*) ppm.

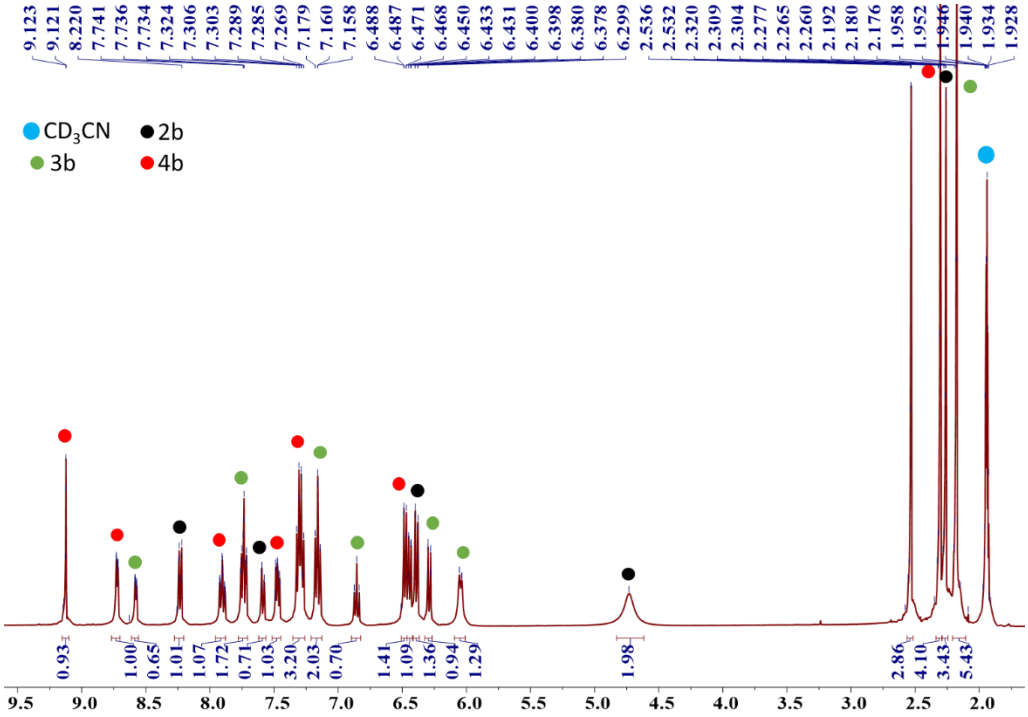

Figure S8: ^{1}H NMR spectrum for the equilibrium of **3b**/**4b** in CD_3CN at 301 K. ^{1}H NMR of **3b** (400 MHz, CD_3CN): δ 8.57 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 7.73 (dd, 3H, *Me-py*^{4}, *py*^{4}), 7.58 (d, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *py*^{3}), 7.30 (dd, $J_{H\text{-}H}$ = 6.80 Hz, 3H, *py*^{5}, *Me-py*^{5}), 6.85 (t, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *CH*), 6.47 (d, $J_{H\text{-}H}$ = 7.20 Hz, 2H, *Me-py*^{3}), 6.04 (d, $J_{H\text{-}H}$ = 8.00 Hz, 2H, *NH*), 2.26 (s, 6H, *Me-py*) ppm. ^{1}H NMR of **4b** (400 MHz, CD_3CN): δ 9.12 (s, 1H, *C=N*), 8.72 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 7.90 (dd, $J_{H\text{-}H}$ = 7.60, 1.20 Hz ,1H, *py*^{4}), 7.47 (dd, $J_{H\text{-}H}$ = 4.80, 1.20 Hz, 1H, *py*^{5}), 7.30 (dd, 3H, py^{3}, *Me-py*^{4}, *Me-py*^{5}), 6.48 (d, $J_{H\text{-}H}$ = 7.20 Hz, 1H, *Me-py*^{3}), 2.30 (s, 3H, *Me-py*) ppm.

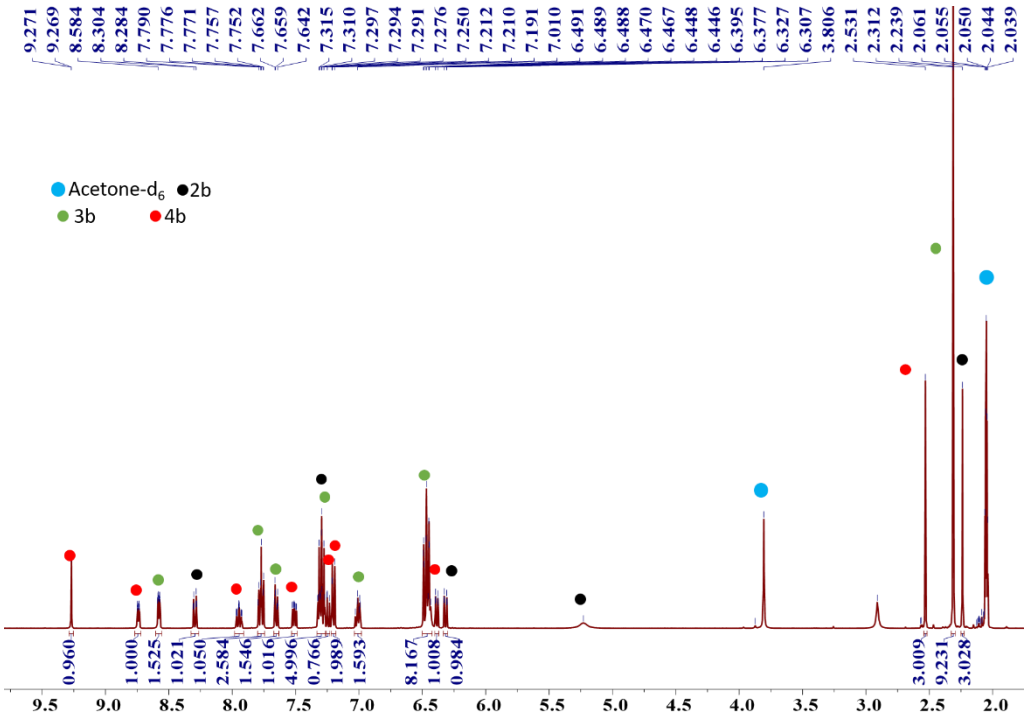

Figure S9: ^{1}H NMR spectrum for the equilibrium of **3b**/**4b** in acetone-d_6 at 301 K. ^{1}H NMR of **3b** (400 MHz, acetone-d_6): δ 8.57 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 7.77 (dd, 3H, *Me-py*^{4}, *py*^{4}), 7.65 (d, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *py*^{3}), 7.30 (dd, $J_{H\text{-}H}$ = 6.80 Hz, 3H, *py*^{5}, *Me-py*^{5}), 7.01 (t, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *CH*), 6.46 (d, $J_{H\text{-}H}$ = 7.20 Hz, 2H, *Me-py*^{3}), 2.31 (s, 6H, *Me-py*) ppm. ^{1}H NMR of **4b** (400 MHz, acetone-d_6): δ 9.27 (s, 1H, *C=N*), 8.74 (d, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{6}), 7.95 (dd, $J_{H\text{-}H}$ = 7.60, 1.20 Hz ,1H, *py*^{4}), 7.50 (dd, $J_{H\text{-}H}$ = 4.80, 1.20 Hz, 1H, *py*^{5}), 7.30 (dd, 3H, py^{3}, *Me-py*^{4}, *Me-py*^{5}), 6.38 (d, $J_{H\text{-}H}$ = 7.20 Hz, 1H, *Me-py*^{3}), 2.53 (s, 3H, *Me-py*) ppm.

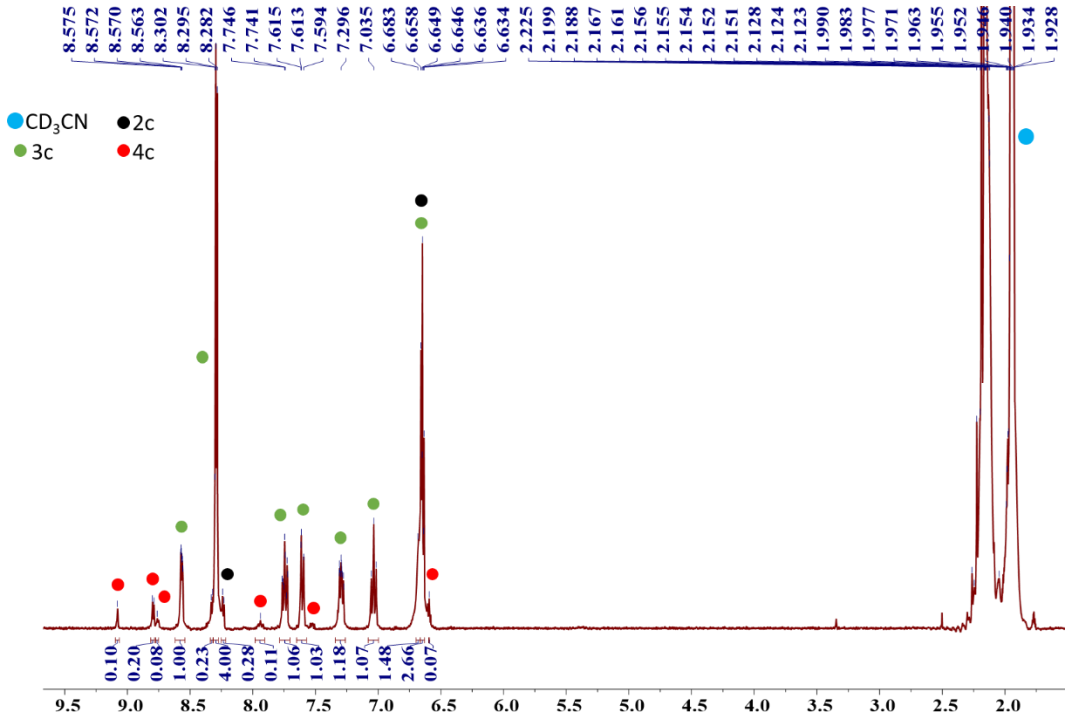

Figure S10: ^{1}H NMR spectrum for the equilibrium of **3c**/**4c** in CD_3CN at 301 K. ^{1}H NMR of **3c** (400 MHz, CD_3CN): δ 8.56 (d, $J_{H\text{-}H}$ = 3.6 Hz, 1H, py^{6}), 8.29 (d, $J_{H\text{-}H}$ = 4.80 Hz, pym^{4,6}), 7.74 (dd, $J_{H\text{-}H}$ = 4.20 Hz, 1H, py^{4}), 7.60 (d, $J_{H\text{-}H}$ = 7.60 Hz, 1H, py^{3}), 7.29 (dd, $J_{H\text{-}H}$ = 5.2 Hz, 1H, py^{5}), 7.03 (t, $J_{H\text{-}H}$=8.00 Hz, 1H, CH), 6.66 (d, $J_{H\text{-}H}$ = 8.00 Hz, 2H, NH), 6.64 (t, $J_{H\text{-}H}$=4.80 Hz, 2H, pym^{5}) ppm. ^{1}H NMR of **4c** (400 MHz, CD_3CN): δ 9.08 (s, 1H, *C*=*N*), 8.79 (d, $J_{H\text{-}H}$ = 5.20 Hz, 2H, *pym*^{4,6}), 8.76 (d, $J_{H\text{-}H}$ = 4.80 Hz, *py*^{6}), 7.94 (dd, $J_{H\text{-}H}$ = 8.40, 1.60 Hz, 1H, *py*^{4}), 7.52 (dd, $J_{H\text{-}H}$ = 4.80, 1.60 Hz, 1H, *py*^{5}), 7.32 (d, $J_{H\text{-}H}$ = 8.4 Hz, 1H, *py*^{3}), 6.59 (t, $J_{H\text{-}H}$=5.20 Hz, 1H, *pym*^{5}) ppm.

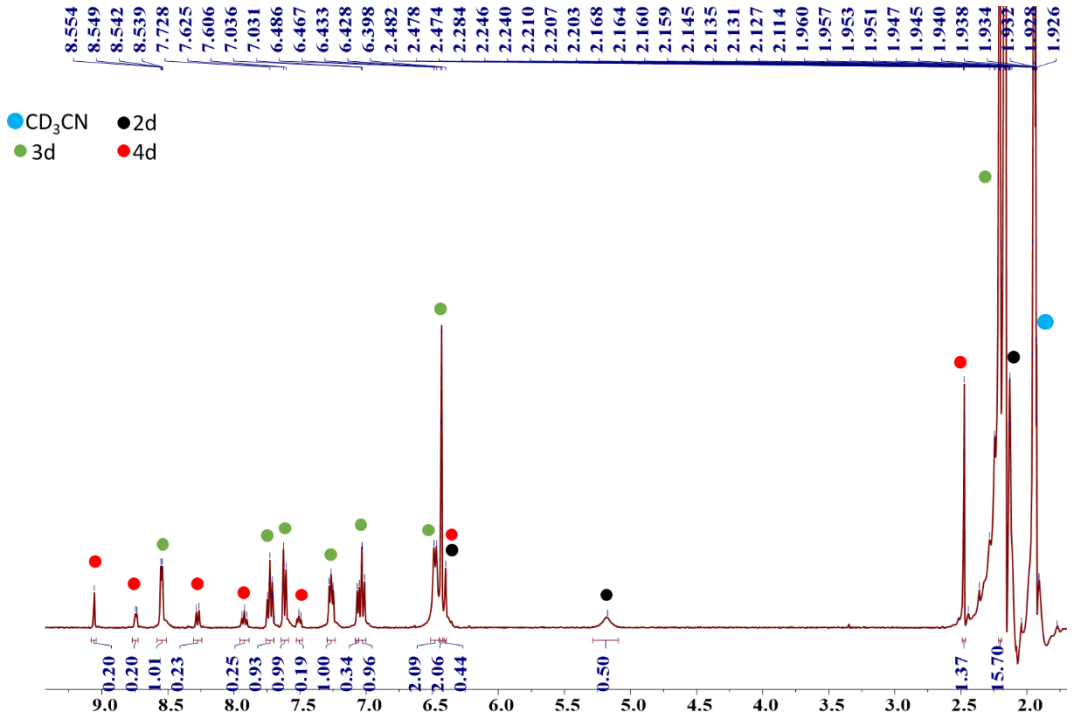

Figure S11: ^{1}H NMR spectrum for the equilibrium of **3d/4d** in CD_3CN at 301 K. ^{1}H NMR of **3d** (400 MHz, CD_3CN): δ 8.54 (d, $J_{H\text{-}H}$ = 2.80 Hz, 1H, *py*^{6}), 7.71 (dd, $J_{H\text{-}H}$ = 4.00 Hz, 1H, *py*^{4}), 7.61 (d, 1H, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *py*^{3}), 7.26 (dd, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{5}), 7.03 (t, $J_{H\text{-}H}$ = 7.60 Hz, 1H, *CH*), 6.47 (d, $J_{H\text{-}H}$ =5.60 Hz, 2H, *NH*), 6.42 (s, 2H, *pym*^{5}), 2.20 (s, 12H, *Me-pym*) ppm. ^{1}H NMR of **4d** (400 MHz, CD_3CN): δ 9.06 (s, 1H, *C=N*), 8.74 (d, $J_{H\text{-}H}$ = 4.80 Hz, *py*^{6}), 8.27 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 7.92 (dd, $J_{H\text{-}H}$ = 7.60, 1.60 Hz, 1H, *py*^{4}), 7.32 (dd, $J_{H\text{-}H}$ = 8.00, 1.60 Hz, 1H, *py*^{5}), 6.40 (s, 1H, pym^{5}), 2.48 (s, 6H, *Me-pym*) ppm.

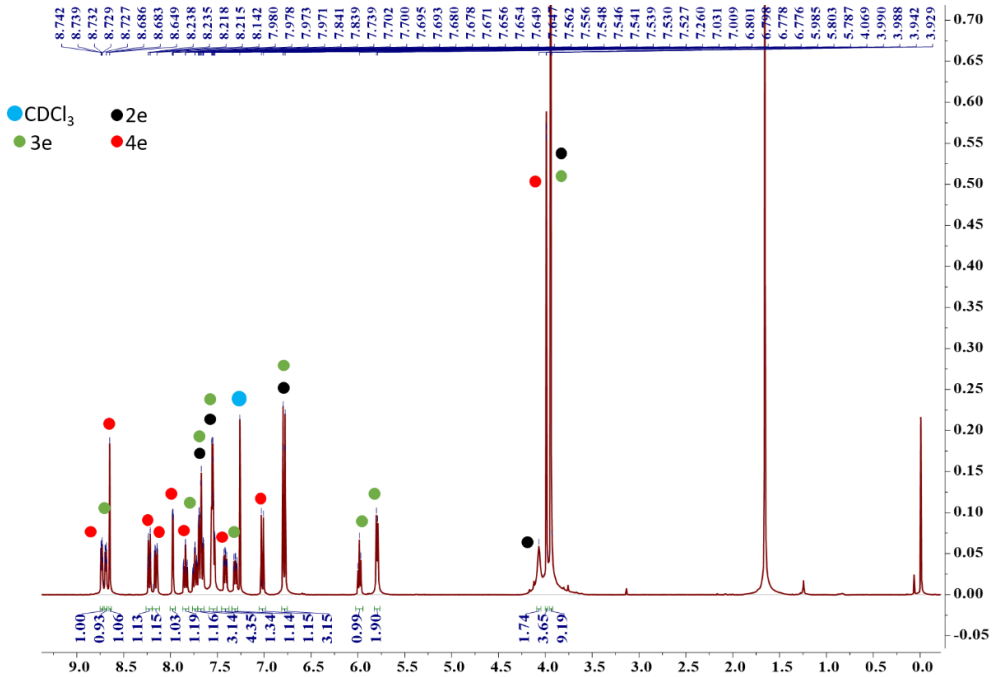

Figure S12: ^{1}H NMR spectrum for the equilibrium of **3e**/**4e** in $CDCl_3$ at 301 K. ^{1}H NMR of **3e** (400 MHz, $CDCl_3$): δ8.70 (d, $J_{H\text{-}H}$ = 4.40 Hz, 1H, *py*^{6}), 7.74 (dd, $J_{H\text{-}H}$ = 7.20, 1.20 Hz, 1H, *py*^{4}), 7.69 (d, $J_{H\text{-}H}$ = 2.40 Hz, 2H, *Ar*^{4}), 7.56-7.53 (m, 3H, py^{3}, *Ar*^{6}), 7.31 (dd, $J_{H\text{-}H}$=4.80, 3.60 Hz, 1H, *py*^{4}), 6.79 (d, $J_{H\text{-}H}$=8.80 Hz, 2H, *Ar*^{3}), 5.99 (t, $J_{H\text{-}H}$=6.40 Hz, 1H, *CH*), 5.80 (d, $J_{H\text{-}H}$=6.00 Hz, 2H, *NH*), 3.94 (s, 6H, -*OMe*) ppm. ^{1}H NMR of **4e** (400 MHz, $CDCl_3$): δ8.74 (d, $J_{H\text{-}H}$ = 4.40 Hz, 1H, *py*^{6}), 8.65 (s, 1H, N=CH), 8.23 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, *py*^{3}), 8.17 (d, $J_{H\text{-}H}$ = 2.80 Hz, 1H, *Ar*^{4}), 7.98 (d, $J_{H\text{-}H}$ = 2.80 Hz, 1H, *Ar*^{6}), 7.84 (dd, $J_{H\text{-}H}$=7.60 Hz, 1H, *py*^{4}), 7.42 (dd, $J_{H\text{-}H}$=4.80, 1.20 Hz, 1H, *py*^{5}), 7.02 (d, $J_{H\text{-}H}$=9.20 Hz, 1H, *Ar*^{3}), 3.99 (s, 3H, -*OMe*) ppm.

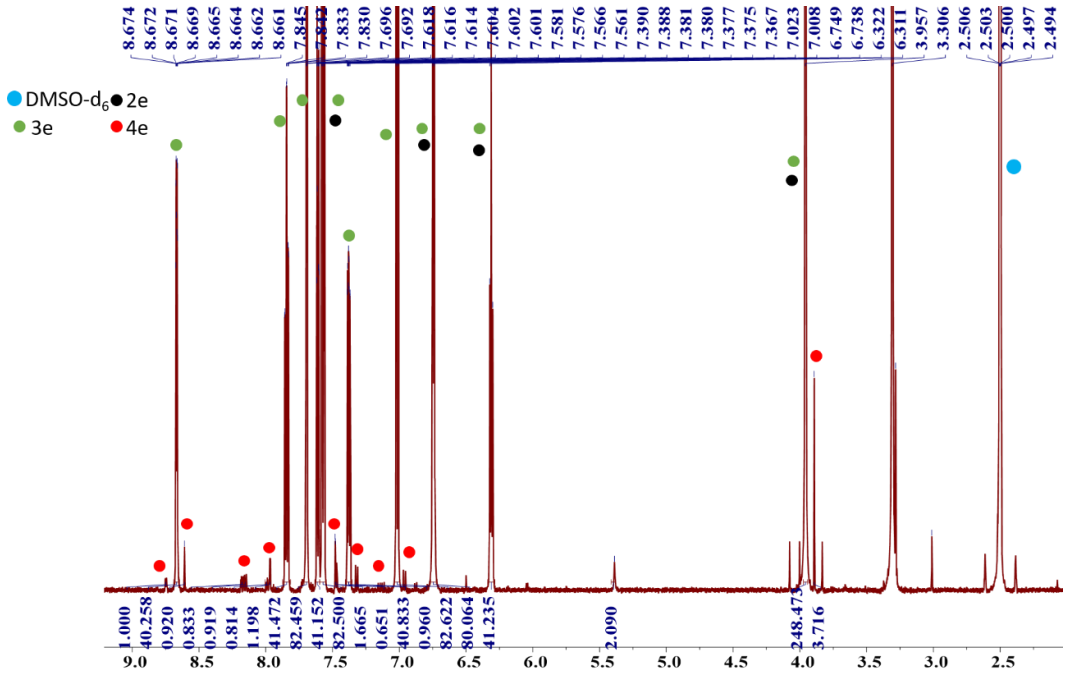

Figure S13: ^{1}H NMR spectrum for the equilibrium of **3e/4e** in DMSO-d_6 at 301 K. ^{1}H NMR of **3e** (400 MHz, DMSO-d_6): δ 8.67 (d, $J_{H\text{-}H}$ = 4.40 Hz, 1H, py^6), 7.85 (dd, $J_{H\text{-}H}$ = 7.20, 1.20 Hz, 1H, py^4), 7.69 (d, $J_{H\text{-}H}$ = 2.40 Hz, 2H, Ar^4), 7.60 (d, $J_{H\text{-}H}$ = 5.60 Hz, 1H, py^3), 7.57 (dd, $J_{H\text{-}H}$ = 5.60, 1.20 Hz 2H, Ar^6), 7.37 (dd, $J_{H\text{-}H}$=4.80, 3.60 Hz, 1H, py^4), 7.01 (d, $J_{H\text{-}H}$=8.80 Hz, 2H, Ar^3), 6.74 (d, $J_{H\text{-}H}$=6.00 Hz, 2H, *NH*), 6.31 (t, $J_{H\text{-}H}$=6.40 Hz, 1H, *CH*), 3.96 (s, 6H, -*OMe*) ppm. ^{1}H NMR of **4e** (400 MHz, DMSO-d_6): δ 8.75 (d, $J_{H\text{-}H}$ = 4.40 Hz, 1H, py^6), 8.60 (s, 1H, *N=CH*), 8.18 (d, $J_{H\text{-}H}$ = 8.00 Hz, 1H, py^3), 8.15 (d, $J_{H\text{-}H}$ = 2.80 Hz, 1H, Ar^4), 7.99 (dd, $J_{H\text{-}H}$=7.60 Hz, 1H, py^4), 7.97 (d, $J_{H\text{-}H}$ = 2.80 Hz, 1H, Ar^6), 7.57 (dd, $J_{H\text{-}H}$ =4.80, 1.20 Hz, 1H, py^5), 6.96 (d, $J_{H\text{-}H}$=9.20 Hz, 1H, Ar^3), 3.96 (s, 3H, -*OMe*) ppm.

(b) Equilibrium Constants

Equilibrium constants were determined by adding different equivalent of amines to aminals which were performed in various d-solvents using a 0.1 M solution (0.5 mL) of aminals containing1,3,5-trimethyl-2,4,6-trinitrobenzene as the internal standard. The amount that 2a was added to 3a is as follows: 2.5, 4.8, 7.5, 11 and 13.2 mg in $CDCl_3$; 1.4, 2.3, 3.6, 4.5 and 6.9 mg in acetone-d_6; 1.0, 2.3, 3.1, 4.8 and 7.3 mg in acetonitrile-d_3; 4.1, 7.4, 9.3, 11.8 and 13.2 mg in DMSO-d_6. The amount that 2b was added to 3b is as follows: 5.1, 13, 19.2, 23.2 and 31.2 mg in $CDCl_3$; 4.6, 7.2, 8.6, 9.9 and 13.9 mg in acetone-d_6; 4.8, 6.7, 8.6, 11.2 and 16.4 mg in acetonitrile-d_3; 9.4, 11.1, 17.8, 25.8 and 39.8 mg in DMSO-d_6.

The equilibrium constant (K) defined as below can be calculated by the integral ratio of aminal, imine and amine species in each spectrum.

$$K = \frac{[aminal]}{[imine][amine]}$$

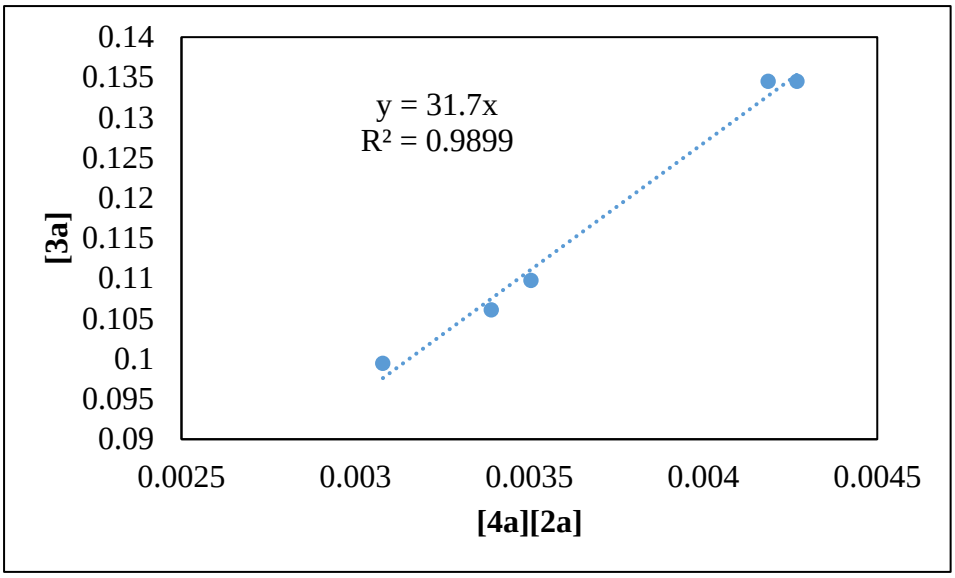

Figure S14: Equilibrium constants of **3a**/**4a** in $CDCl_3$ at 301 K.

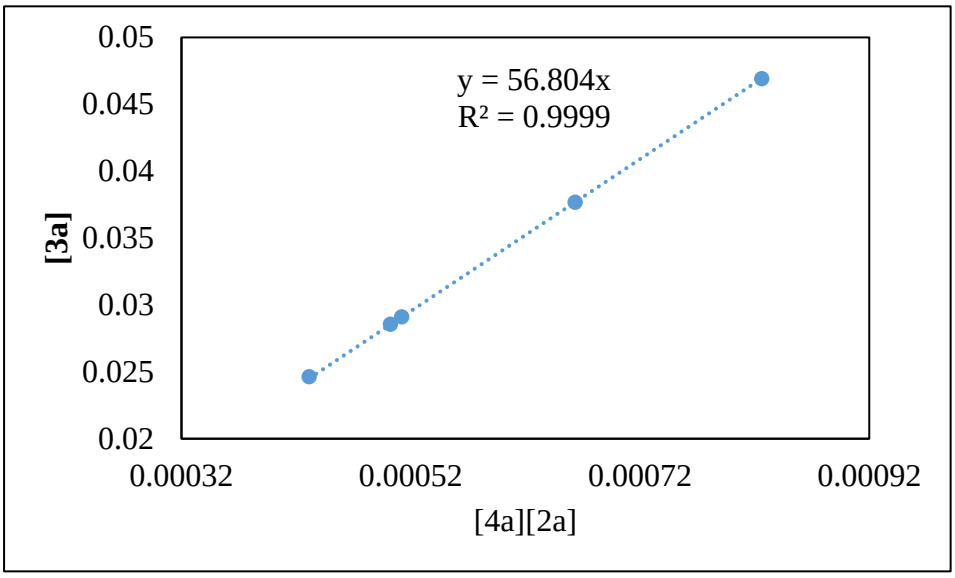

Figure S15: Equilibrium constants of **3a**/**4a** in acetone-d_6 at 301 K.

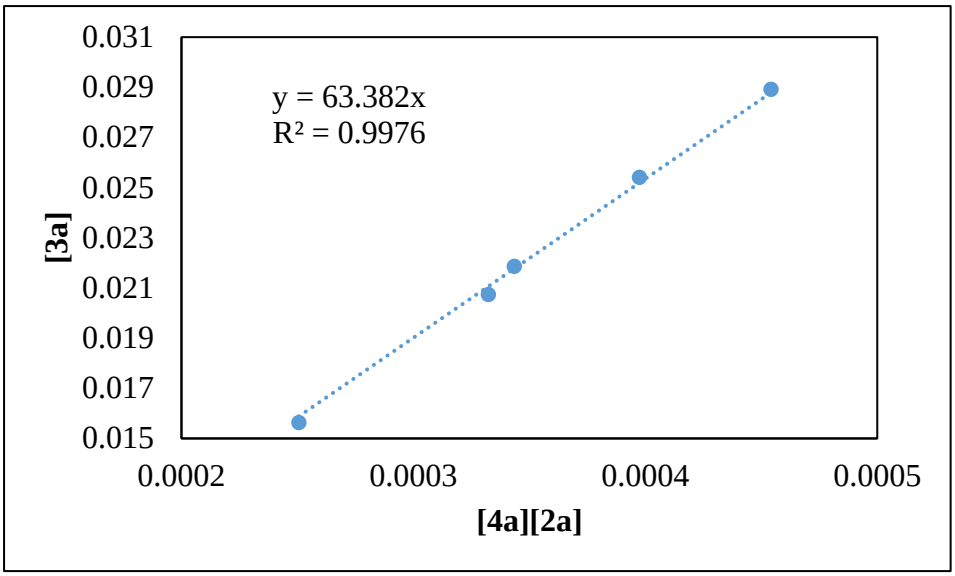

Figure S16: Equilibrium constants of **3a**/**4a** in acetonitrile-d_3 at 301 K.

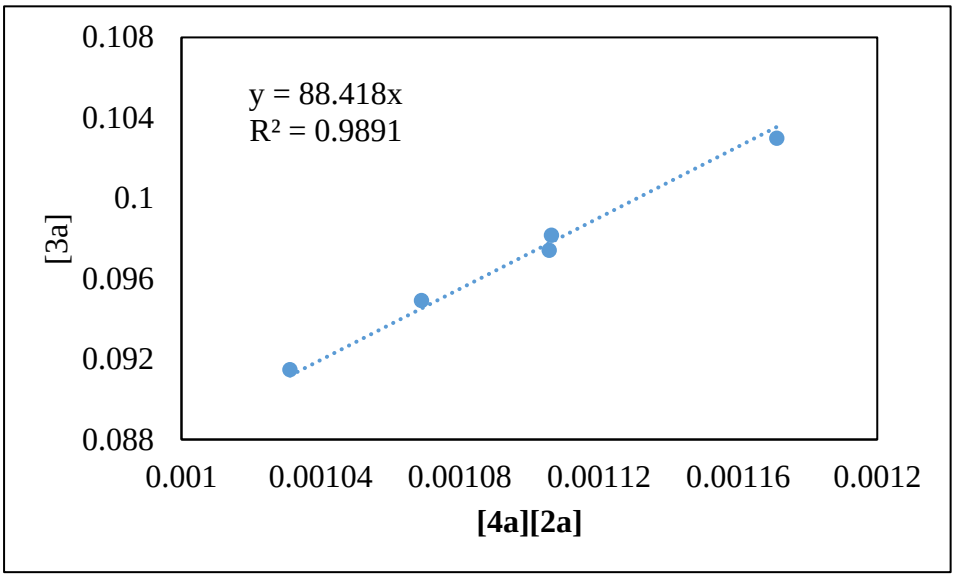

Figure S17: Equilibrium constants of **3a**/**4a** in DMSO-d_6 at 301 K.

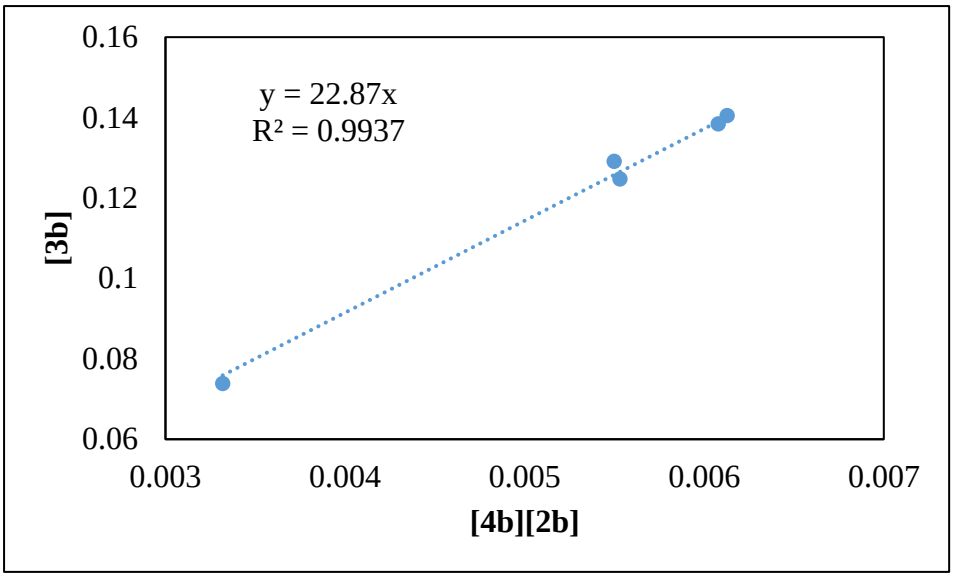

Figure S18: Equilibrium constants of **3b**/**4b** in $CDCl_3$ at 301 K.

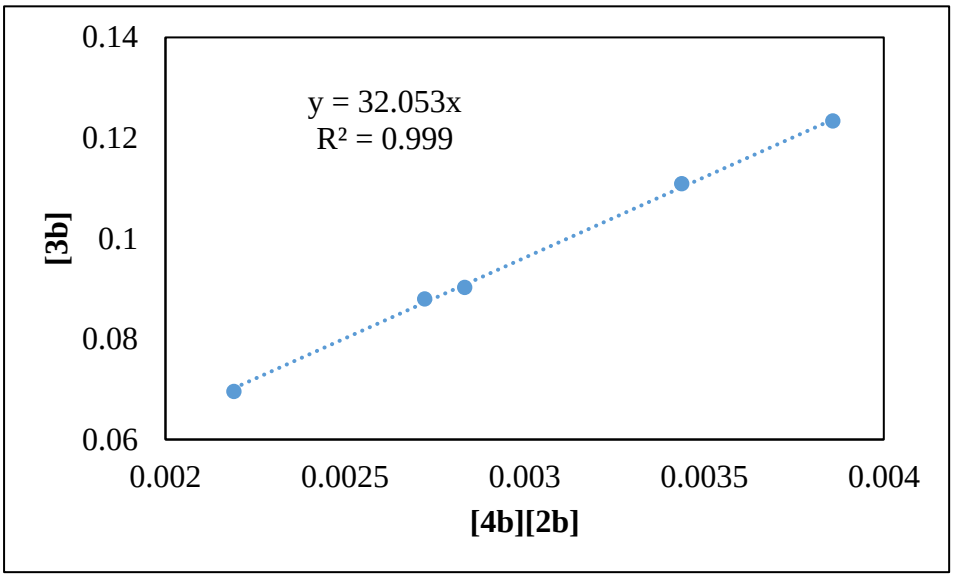

Figure S19: Equilibrium constants of **3b**/**4b** in acetone-d_6 at 301 K.

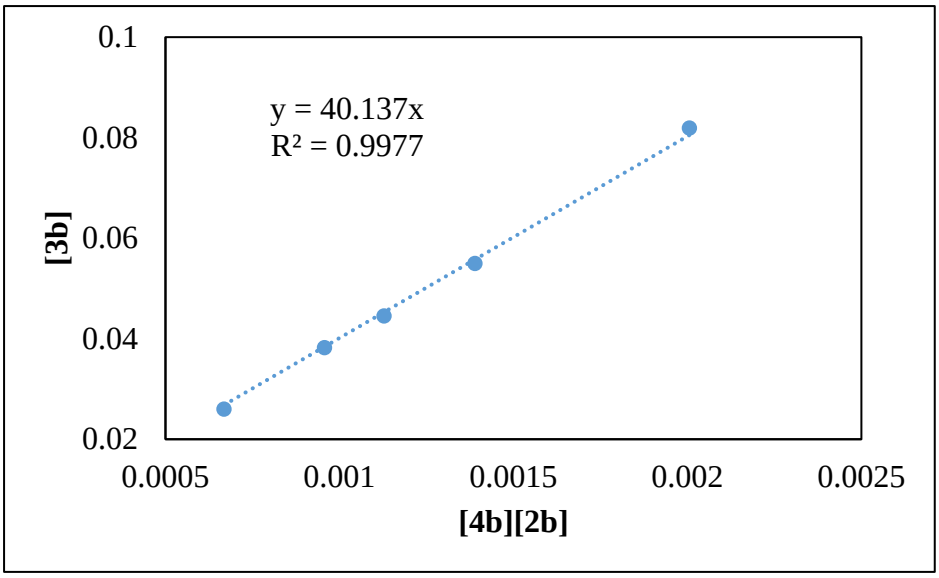

Figure S20: Equilibrium constants of **3b**/**4b** in acetonitrile-d_3 at 301 K.

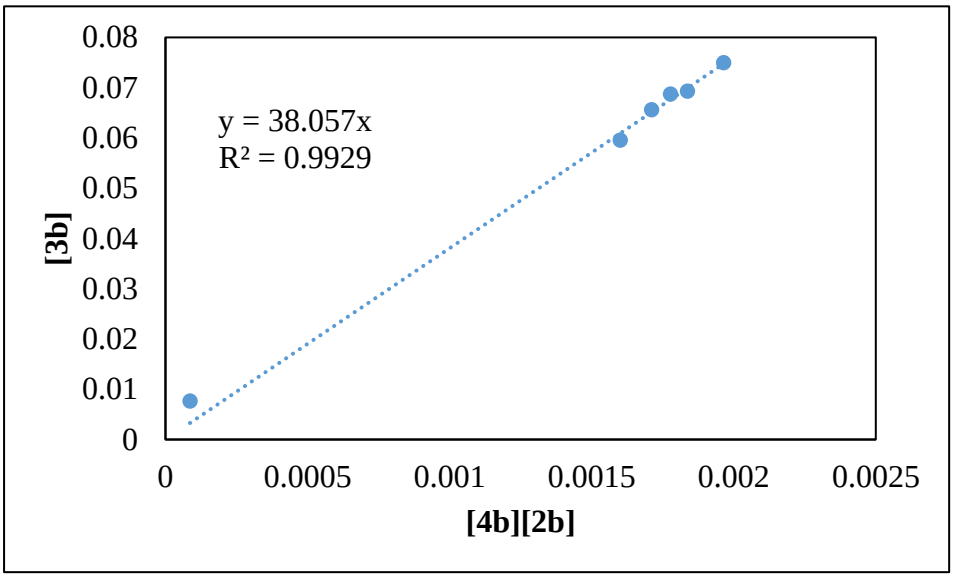

Figure S21: Equilibrium constants of **3b**/**4b** in DMSO-d_6 at 301 K.

(c) Solvent Effect

Considered the solubility of the aminals, the following concentration were used for the ^{1}H NMR measurements. The initial concentrations of **3a** in $CDCl_3$, DMSO-d_6, acetone-d_6, CD_3CN, CD_3NO_2, and pyridine-d_5 are 0.096, 0.096, 0.038, 0.038, 0.038 and 0.056 M, respectively. The initial concentrations of **3b** in $CDCl_3$, DMSO-d_6, acetone-d_6, CD_3CN, CD_3NO_2, and pyridine-d_5 are 0.099, 0.072, 0.035, 0.035, 0.035 and 0.060 M, respectively. The initial concentrations of **3c** in $CDCl_3$, DMSO-d_6, acetone-d_6, CD_3CN, CD_3NO_2, and pyridine-d_5 are 0.069, 0.069, 0.032, 0.032, 0.032 and 0.046 M, respectively. The initial concentrations of **3d** in $CDCl_3$, DMSO-d_6, acetone-d_6, CD_3CN, CD_3NO_2, and pyridine-d_5 are 0.062, 0.062, 0.025, 0.025, 0.025 and 0.035 M, respectively.

Table S3 Aminal/imine ratios measured in different solvents at 301 K

d-solvent (ε)	3a/4a	3b/4b	3c/4c	3d/4d
$CDCl_3$ (4.81)	55/45	51/49	100/0	100/0
Pyridine-d_5 (12.4)	70/30	74/26	100/0	100/0
Acetone-d_6 (20.7)	57/43	60/40	96/4	97/3
CD_3CN (37.5)	53/47	43/57	90/10	84/16
CD_3NO_2 (35.9)	48/52	36/64	95/5	90/10
DMSO-d_6 (46.7)	74/26	55/45	100/0	100/0

Responsiveness of aminals to the temperature stimulus: Van't Hoff plot

Variable Temperature ^{1}H NMR spectra were acquired from 301 to 403 K in DMSO-d_6, in temperature interval of 15 K. The equilibrium quotient (K_{eq}) defined as below can be calculated by the integral ratio of aminal, imine and amine species in each spectrum.

$$K_{eq} = \frac{[aminal]}{[imine][amine]}$$

The standard binding enthal*py* ($\triangle H^0$) and the standard combined entro*py* ($\triangle S^0$) of each system can be obtained by Van't Hoff equation.

$$\Delta G^0 = \Delta H^0 - T\Delta S^0$$

$$\Delta G^0 = -RT \ln K$$

$$\ln K = -\Delta H^0/RT + \Delta S^0/R$$

When a plot of ln K against 1/T has been prepared, ΔH^0 can be obtained from the slope ($-\Delta H^0/R$) and ΔS^0 from the intercept ($\Delta S^0/R$).

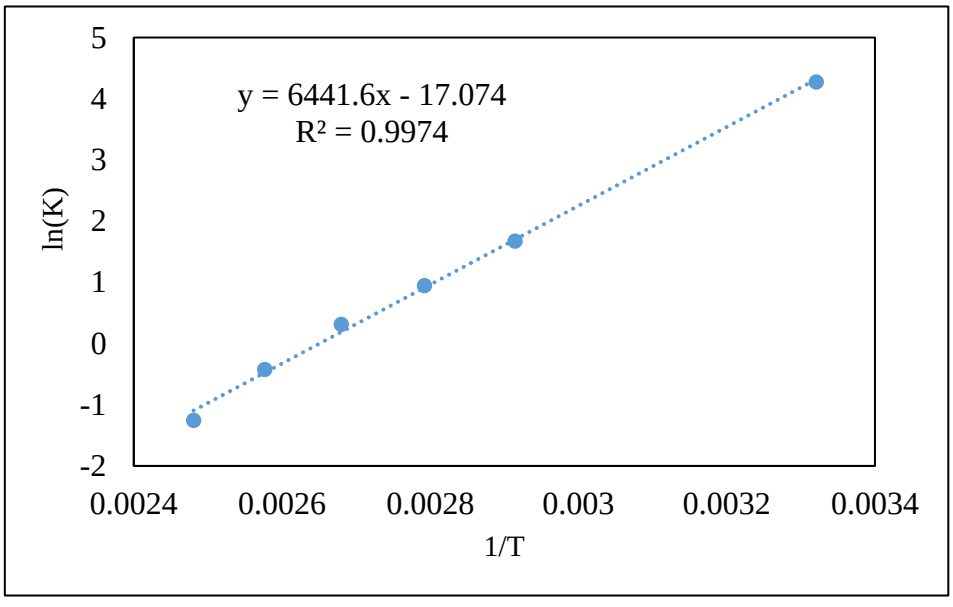

Figure S22: Van't Hoff plot for the **3a**/**4a** system.

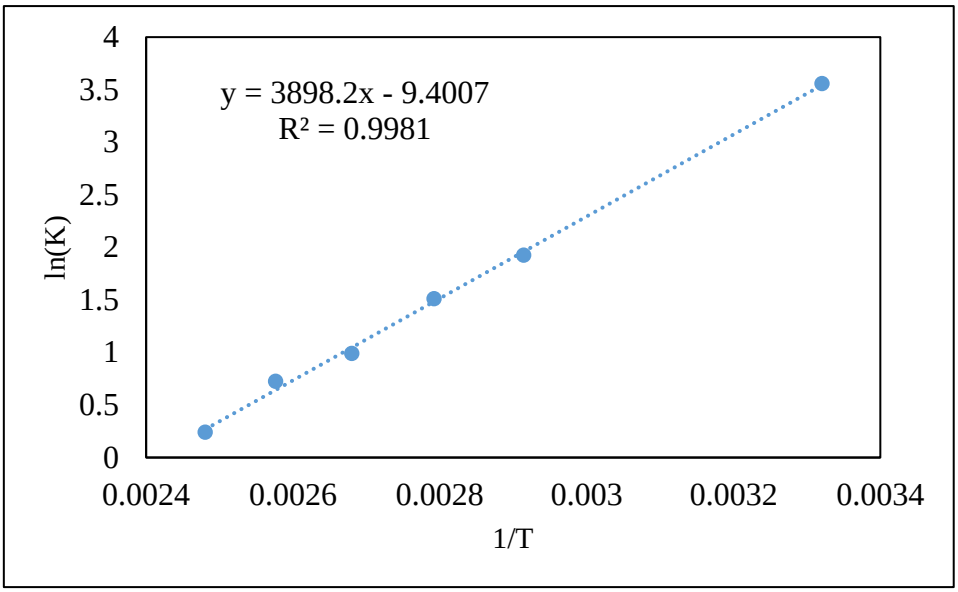

Figure S23: Van't Hoff plot for the **3b/4b** system.

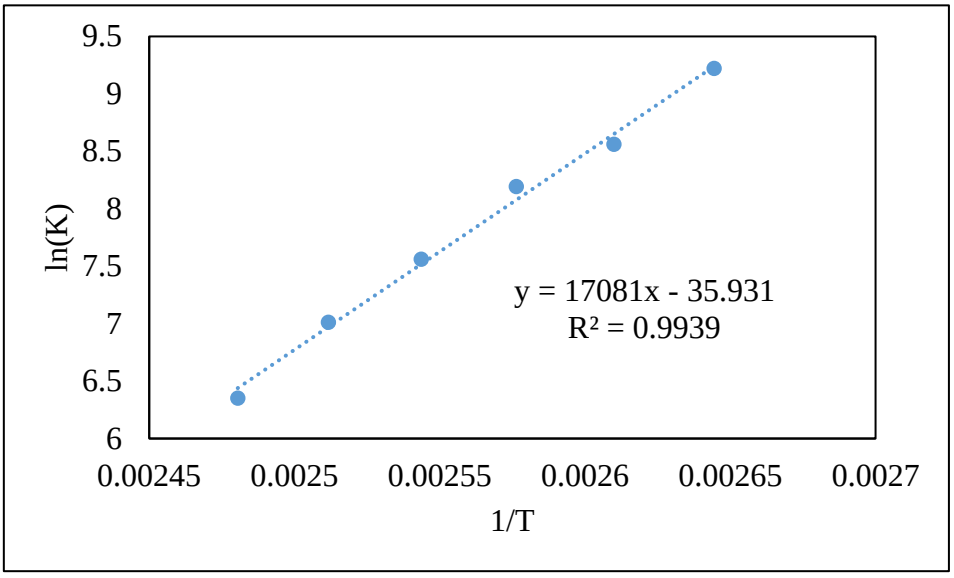

Figure S24: Van't Hoff plot for the **3c/4c** system.

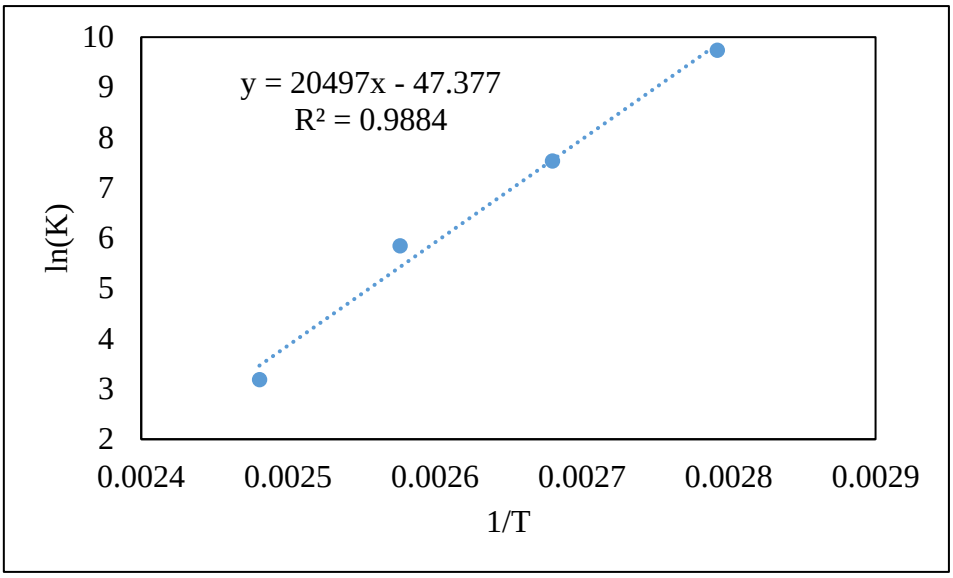

Figure S25: Van't Hoff plot for the **3d/4d** system

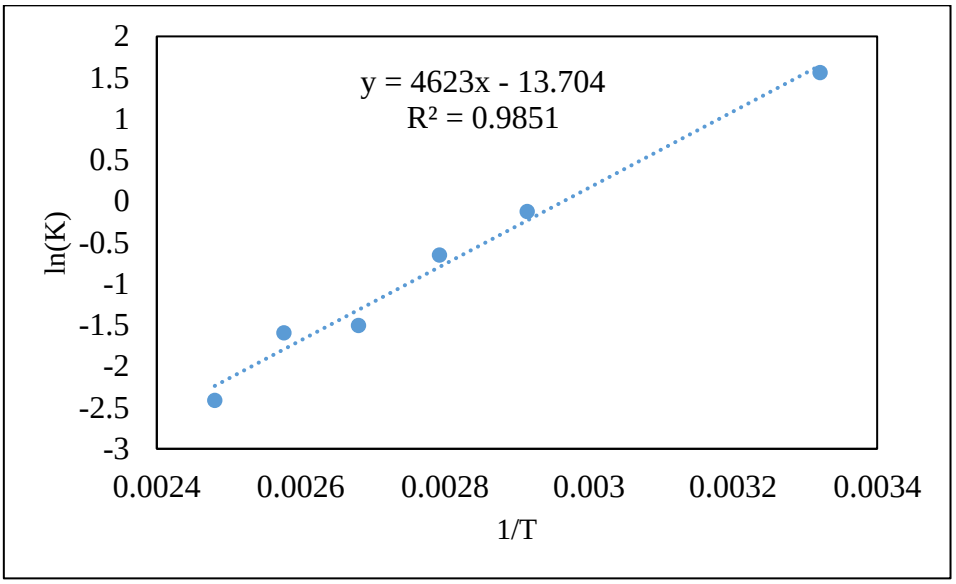

Figure S26: Van't Hoff plot for the **3e/4e** system.

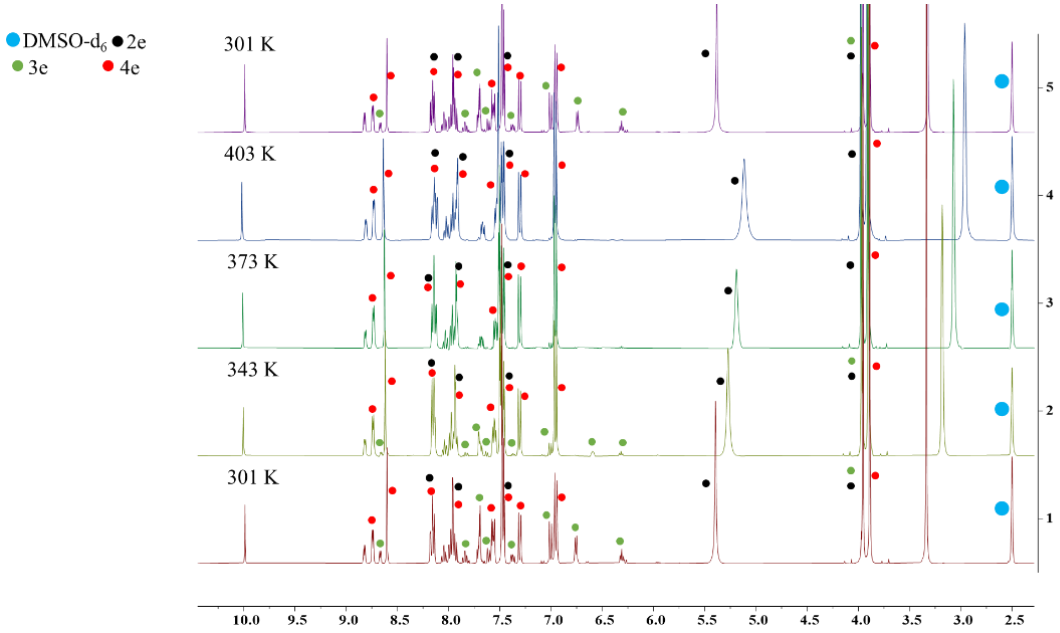

Figure S27: ^{1}H NMR spectra for the equilibrium of **3e**/**4e** in DMSO-d_6 at 301 K, 343 K, 373 K, 403 K and cooling at 301 K.

Responsiveness of aminals to the acid/base stimulus

NMR titration experiments were performed in $CDCl_3$ using a 0.13 M solution (0.4 mL) of **3b** as a blank solution. A 0.21 M solution of AcOH/ a 0.85 M solution of NEt_3 was added stepwise, and the results are listed in Figure S27 and Figure S28.

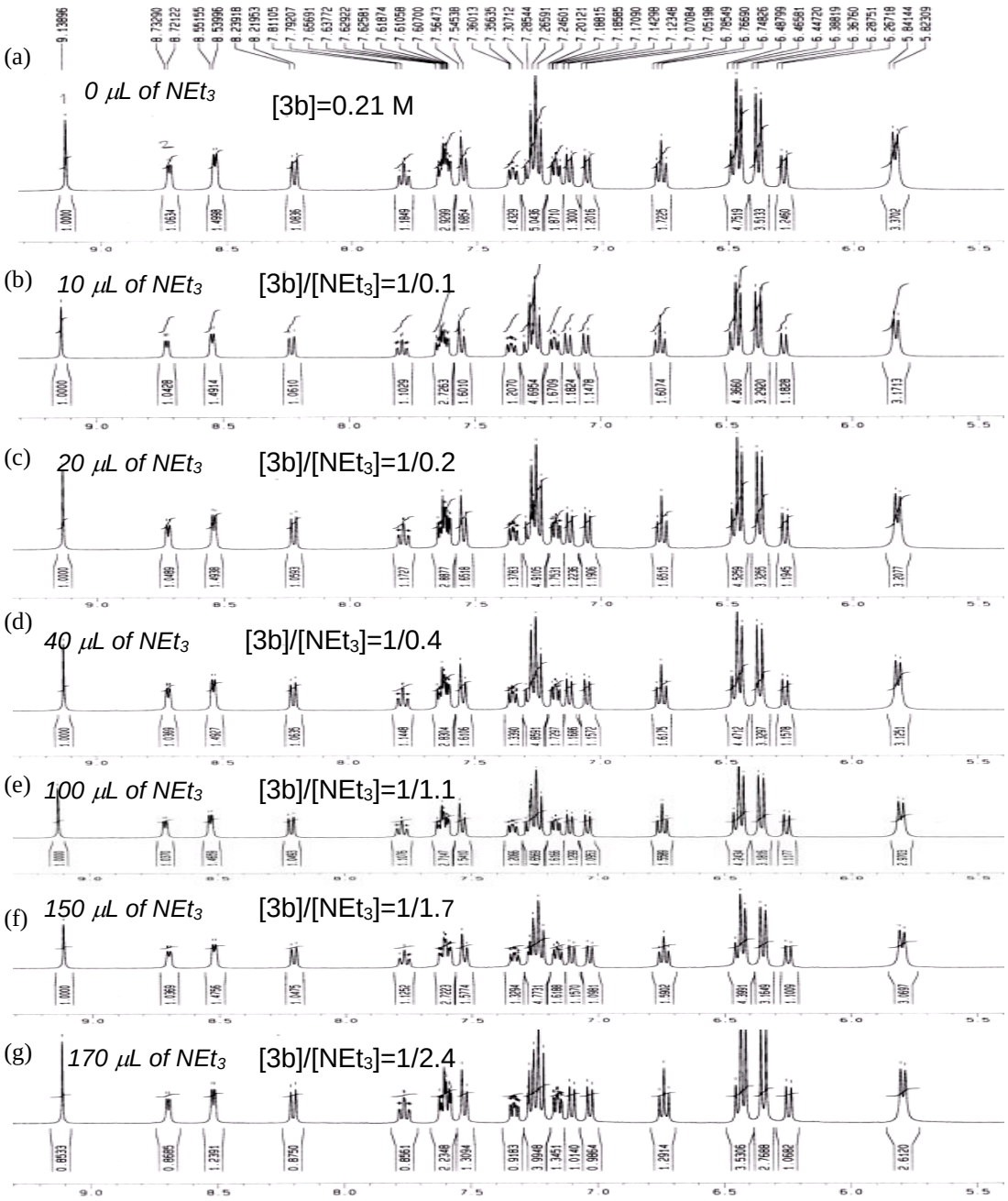

Figure S28: Base titration of **3b/4b** in $CDCl_3$.

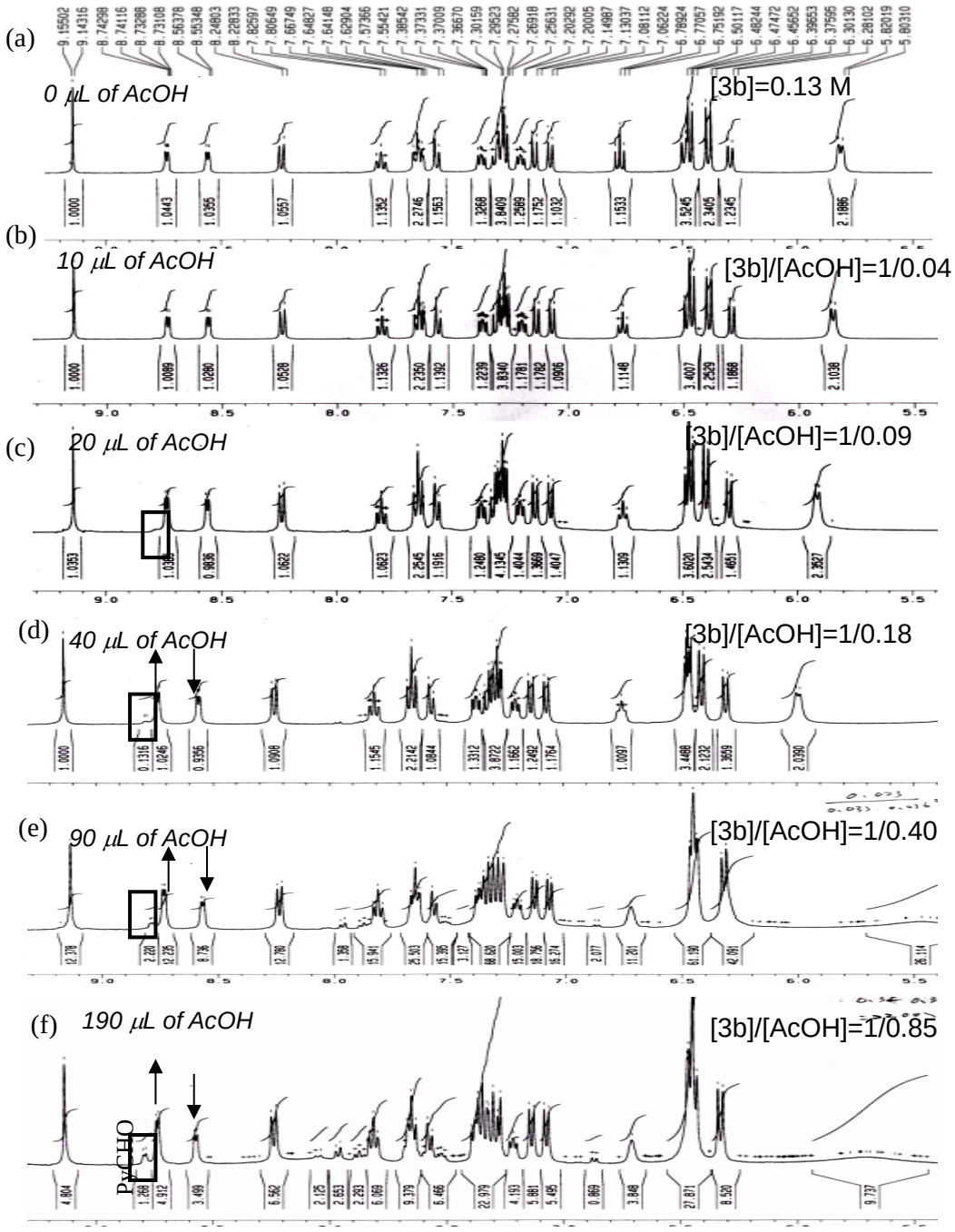

Figure S29: Acid titration of **3b**/**4b** in $CDCl_3$.