Electronic Supplementary Material (ESI) for Organic & Biomolecular Chemistry

Supporting Information

$Hg(OTf)_2$-Catalyzed Direct Vinylation of Tryptamines and Versatile Applications for Tandem Reactions

Haruki Mizoguchi, Hideaki Oikawa and Hiroki Oguri*

General: NMR spectra were recorded on JEOL JNM-ECX 400 (^{1}H/400 MHz, ^{13}C/100 MHz) spectrometers. Chemical Shifts are reported in δ (ppm) using chloroform, acetonitrile and dimethyl sulfoxide as an internal standard of δ 7.26, 1.94, 2.50 and 77.16, 118.26, 39.52 for ^{1}H and ^{13}C-NMR, respectively. The medium pressure liquid chromatography (MPLC) purifications were performed on a YAMAZEN YFLC-AI-580. Analytical ultra performance liquid chromatography (UPLC) was carried out on WATERS ACQUITY^{TM} UPLC® H-Class system with ACQUITY UPLC® BEH C18 1.7 μm 2.1×50 mm column and PDA detector (210-400 nm). Sample was dissolved in MeCN and UPLC fractionation conditions consisted of a linear gradient from 50% H_2O/50% MeCN to 5% H_2O/95% MeCN in 3 min at a flow rate of 0.5 mL/min, held at MeCN 100% for 0.50 min at a flow rate of 0.5 mL/min, then a convex gradient back to 80% H_2O/20% MeCN in 0.5 min at a flow rate of 0.5 mL/min, then held at 80% H_2O/20% MeCN for 0.5 min at a flow rate of 0.5 mL/min. Total run time for each injection was 4.5 min. Compound was detected by 252 nm UV absorption and characterized by photo diode array. Analytical high performance liquid chromatography (HPLC) was carried out on GILSON 321pump equipped with a GILSON UV/VIS-151 detector, GILSON FC203B fraction collector and Inertsil® SIL-100A 10×250 mm column. Where necessary, solvents were distilled from appropriate drying agents prior to use. Flash column chromatography was performed using Kanto Silica Gel 60N.

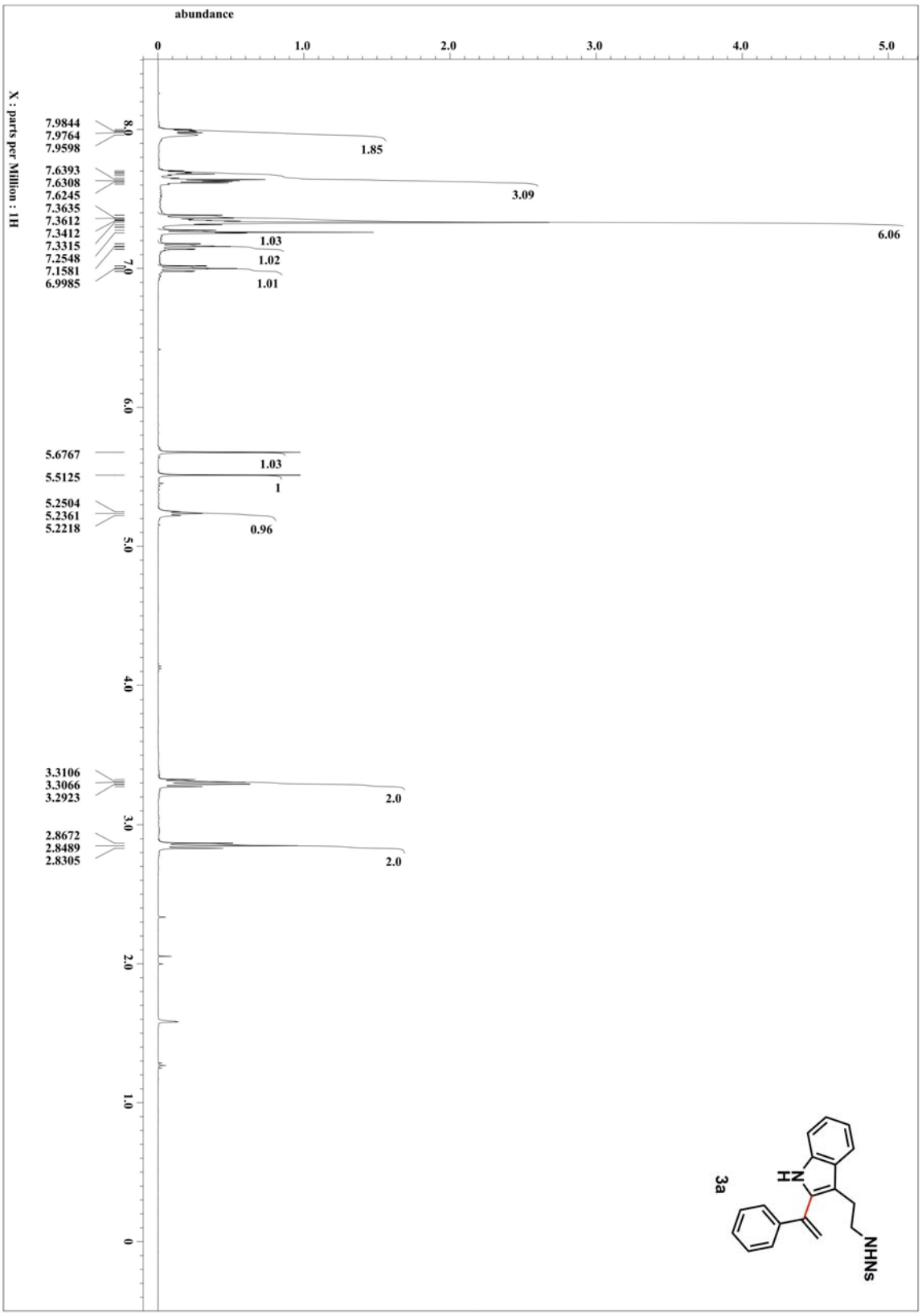


Figure S1. A ^{1}H-NMR spectrum of **3a** in $CDCl_3$

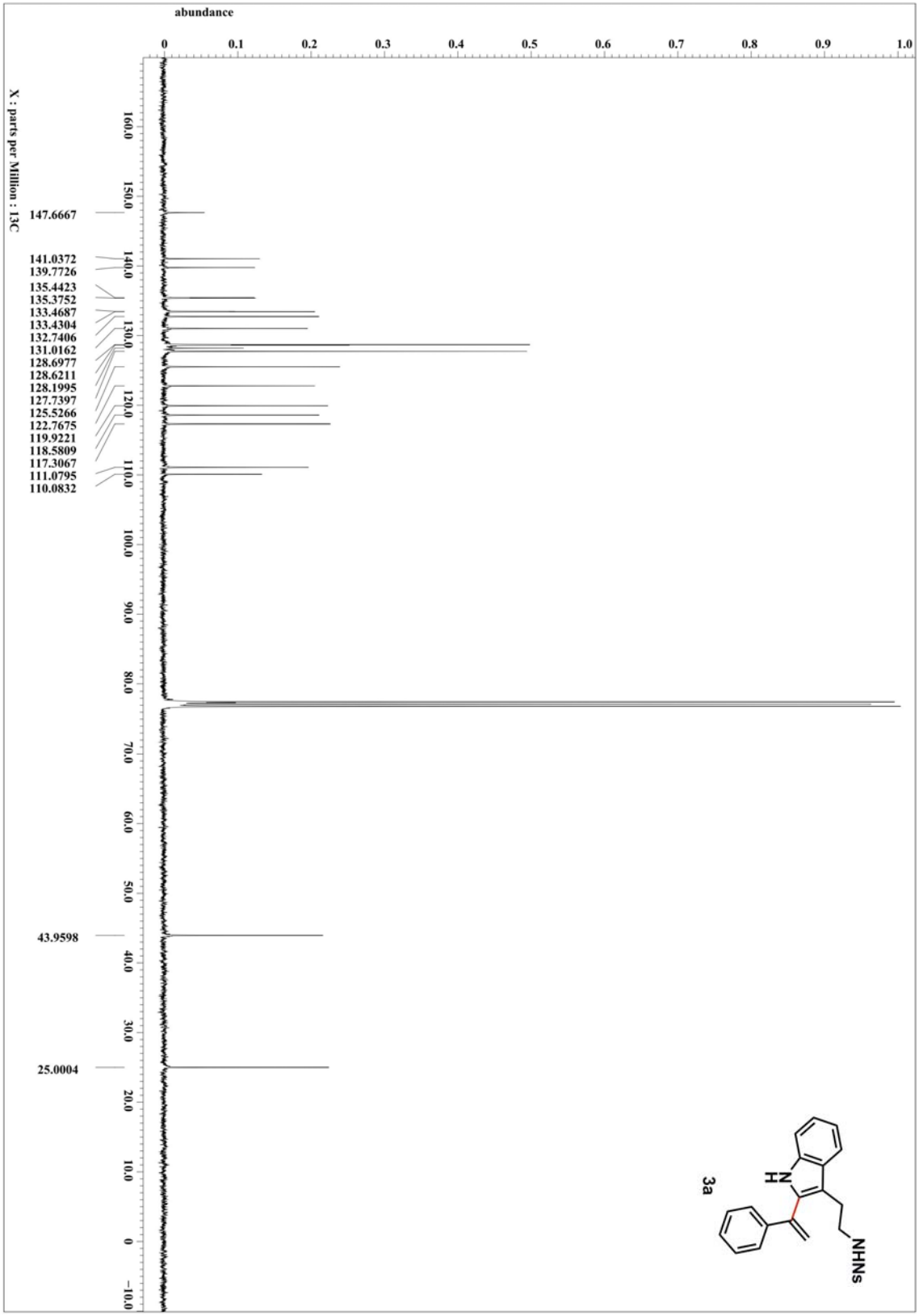


Figure S2. A ^{13}C-NMR spectrum of **3a** in $CDCl_3$

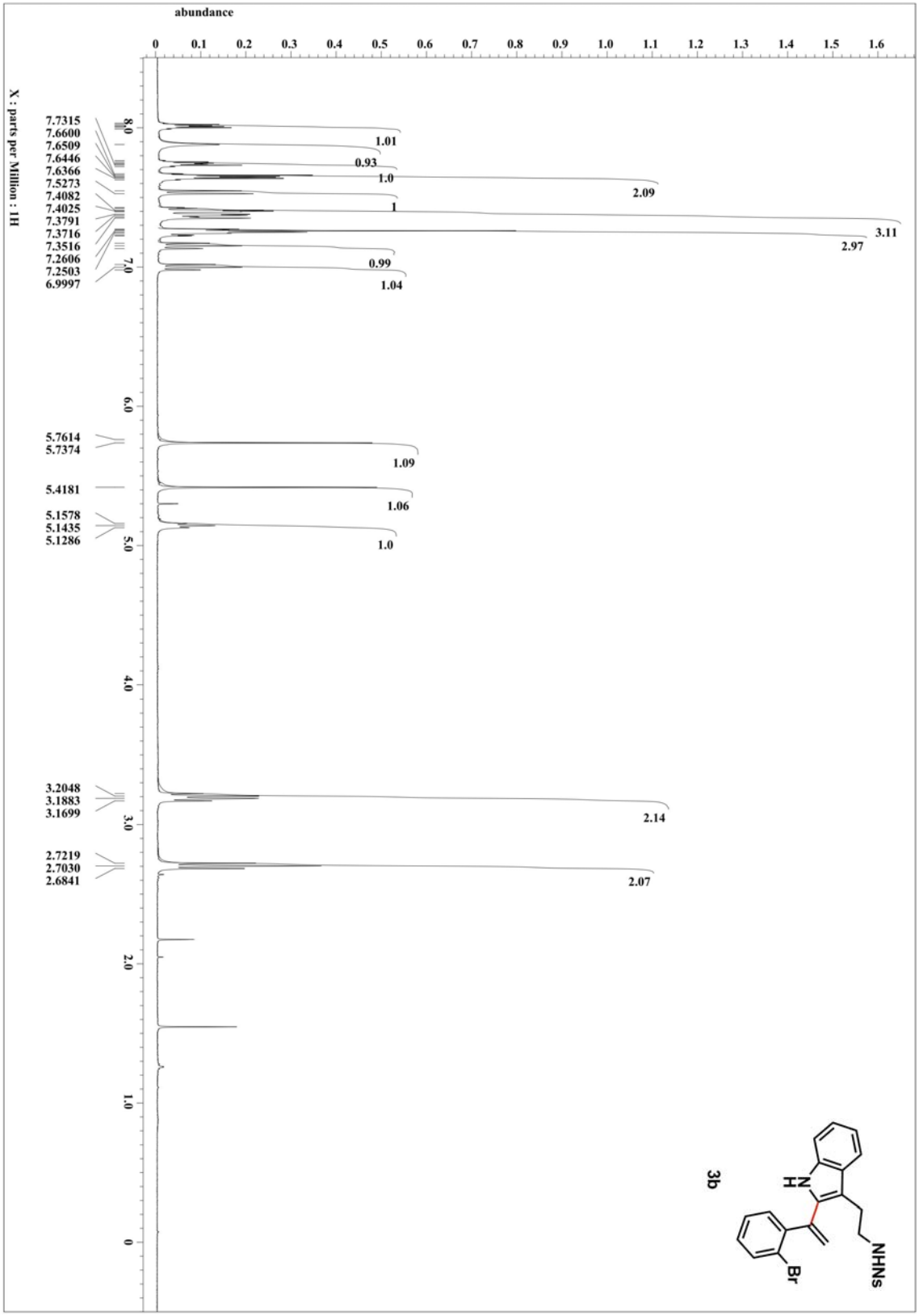


Figure S3. A ^{1}H-NMR spectrum of **3b** in $CDCl_3$

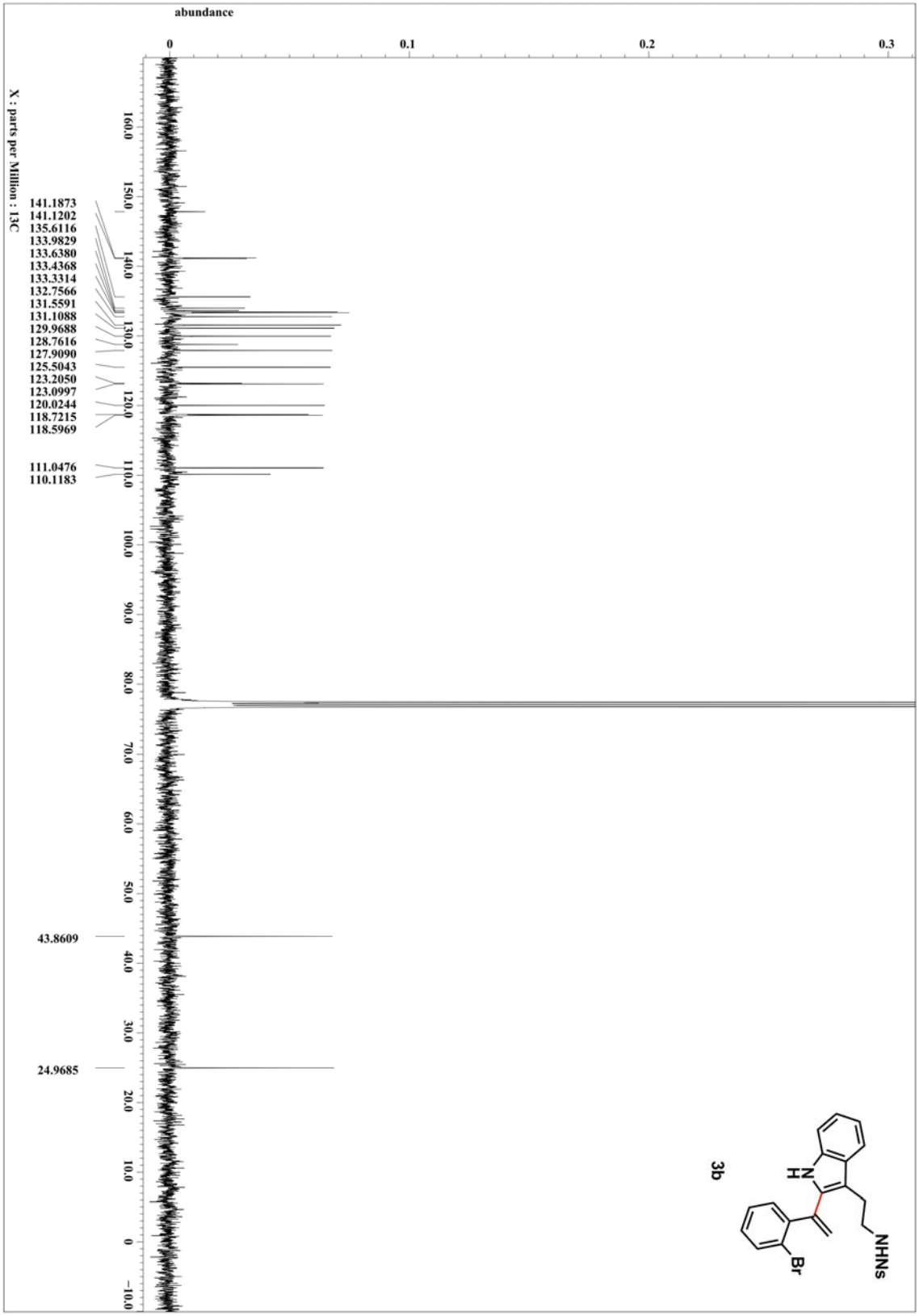


Figure S4. A ^{13}C-NMR spectrum of **3b** in $CDCl_3$

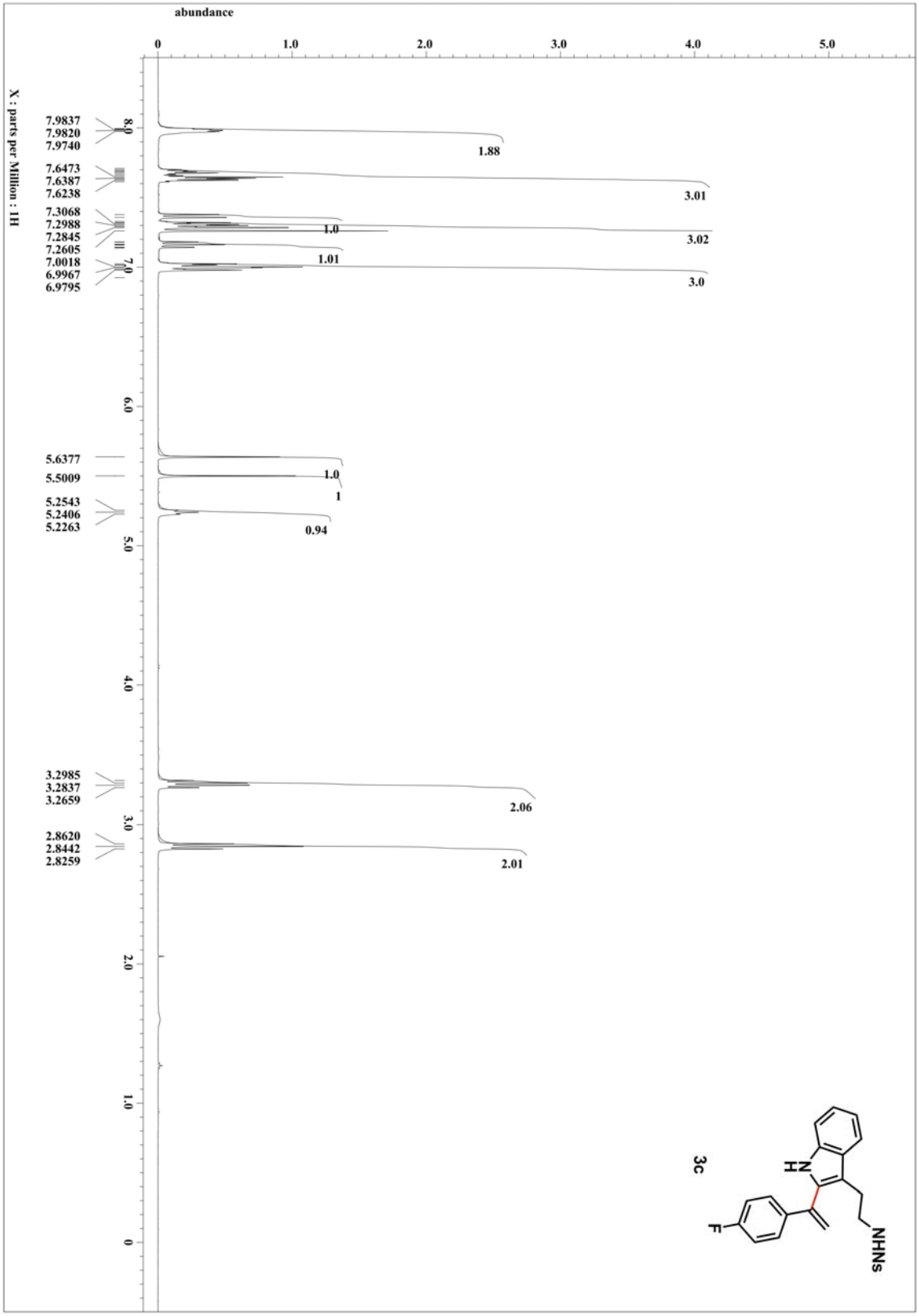


Figure S5. A ^{1}H-NMR spectrum of **3c** in $CDCl_3$

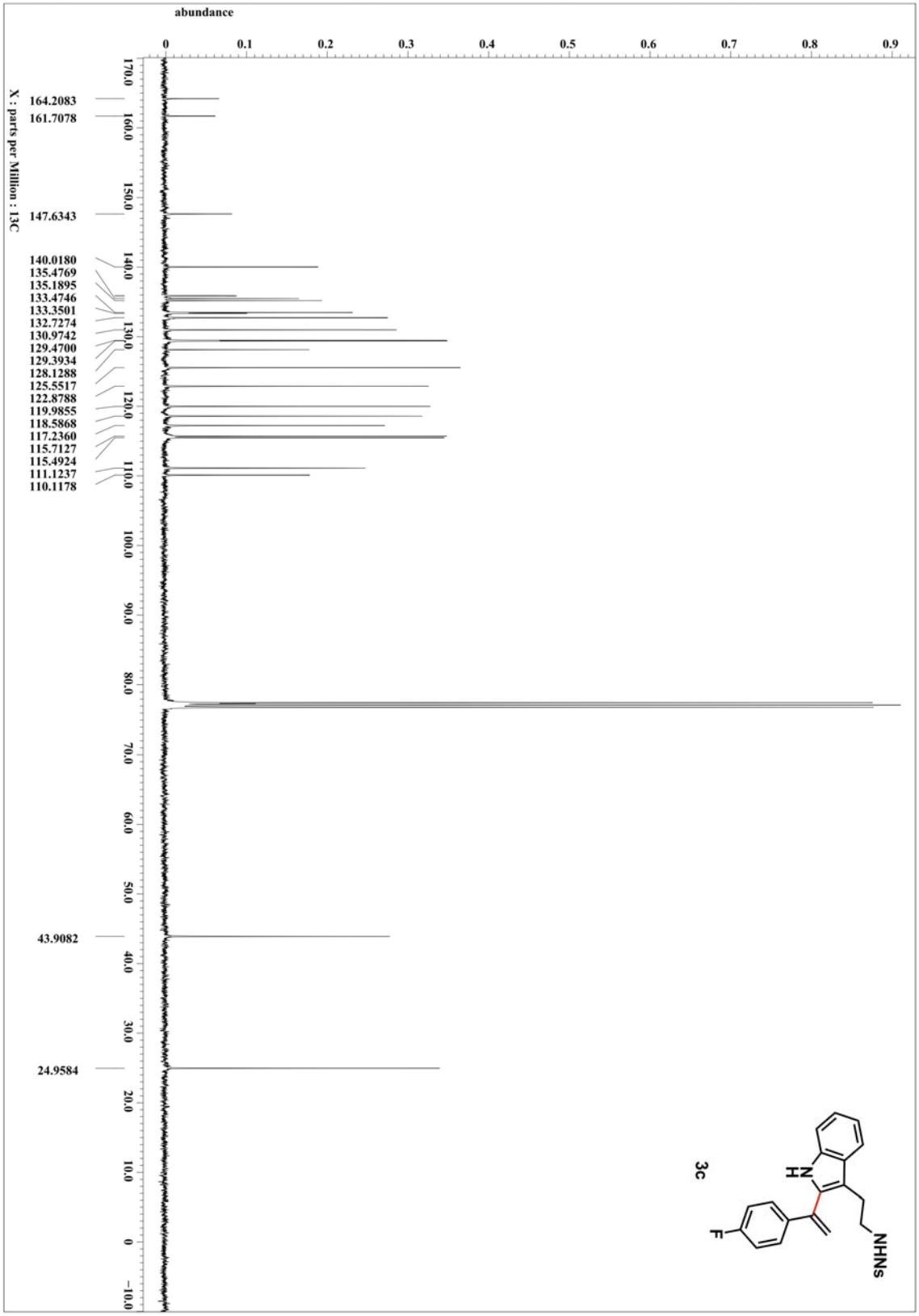


Figure S6. A ^{13}C-NMR spectrum of **3c** in $CDCl_3$

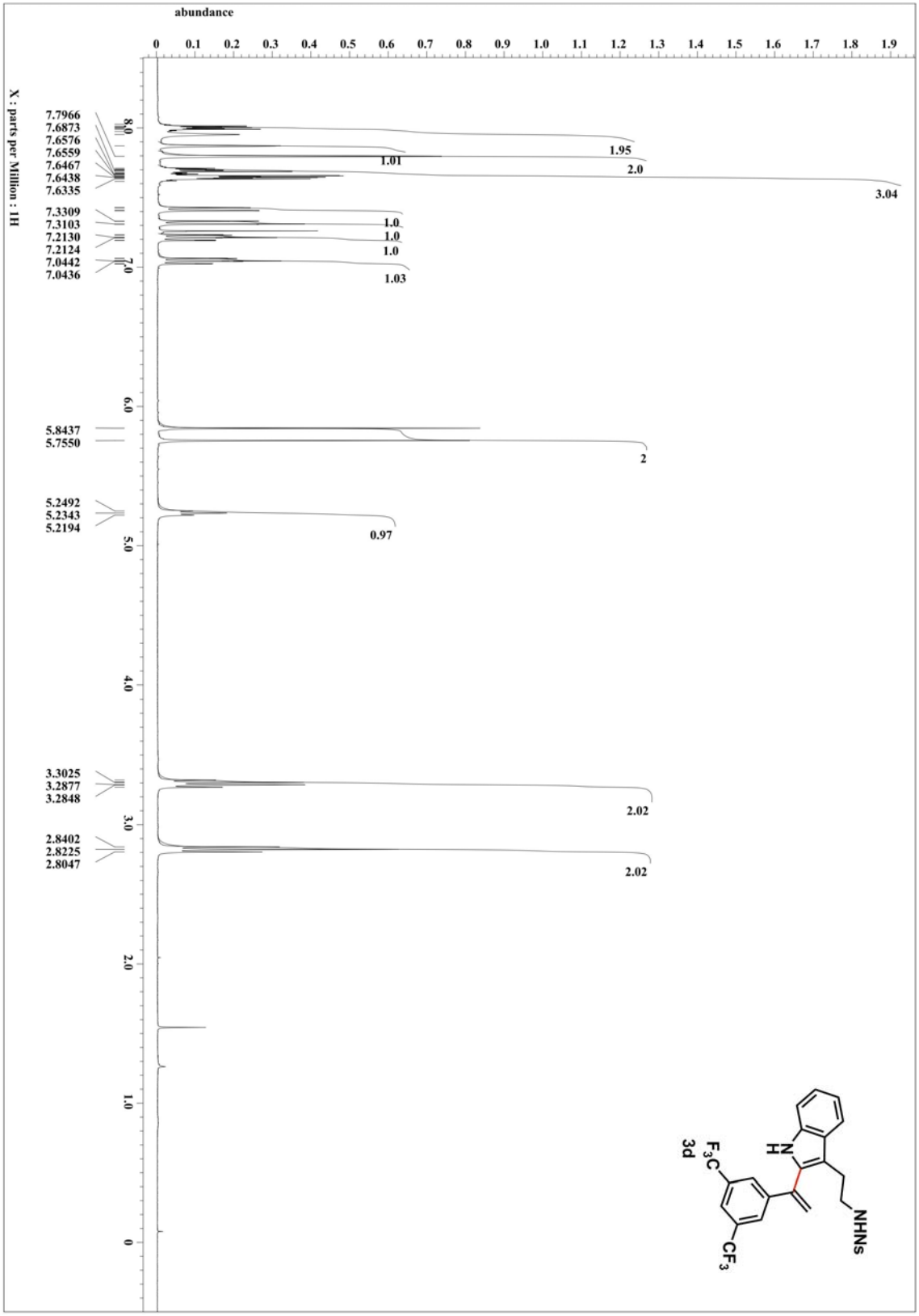


Figure S7. A ^{1}H-NMR spectrum of **3d** in $CDCl_3$

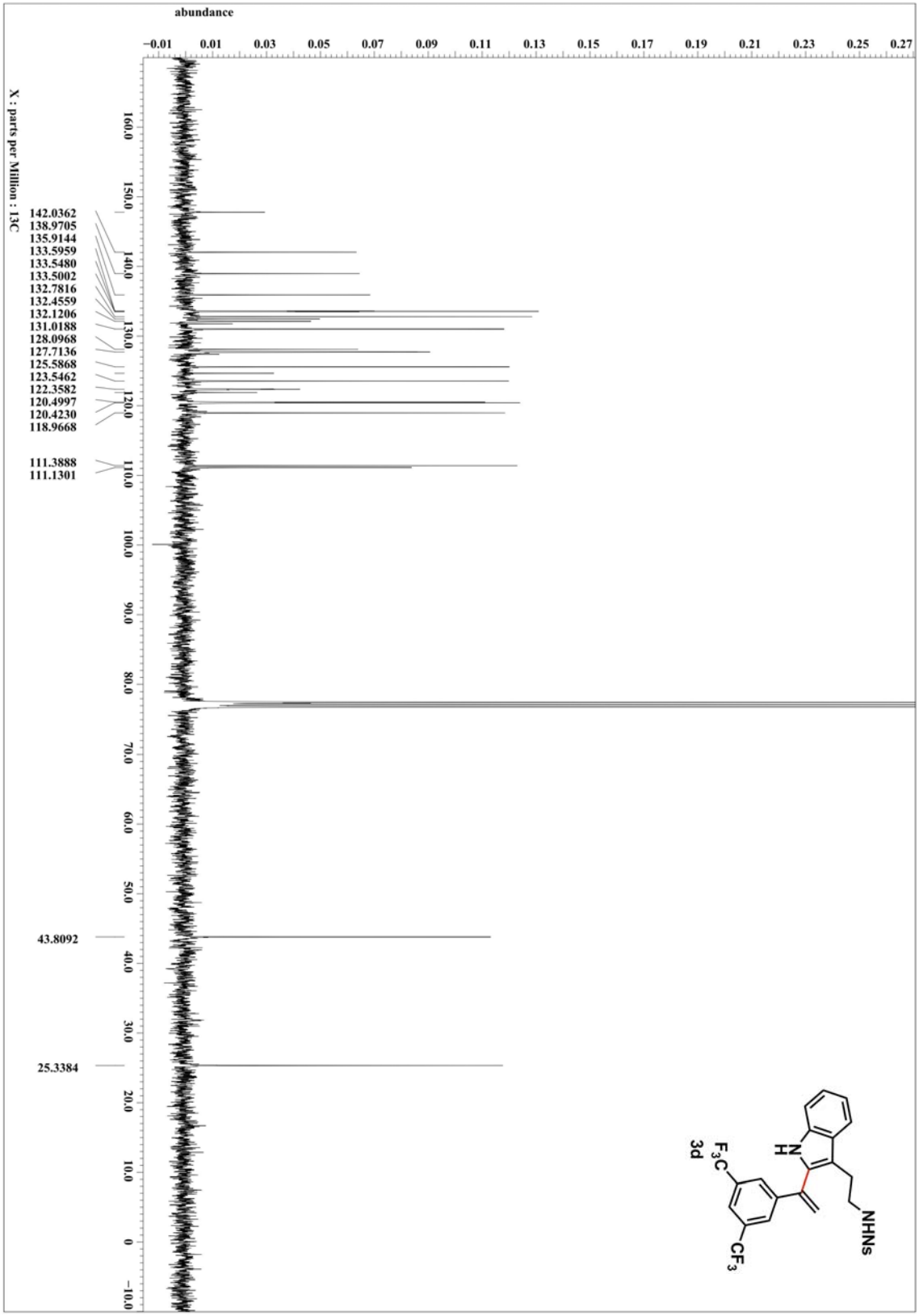


Figure S8. A ^{13}C-NMR spectrum of **3d** in $CDCl_3$

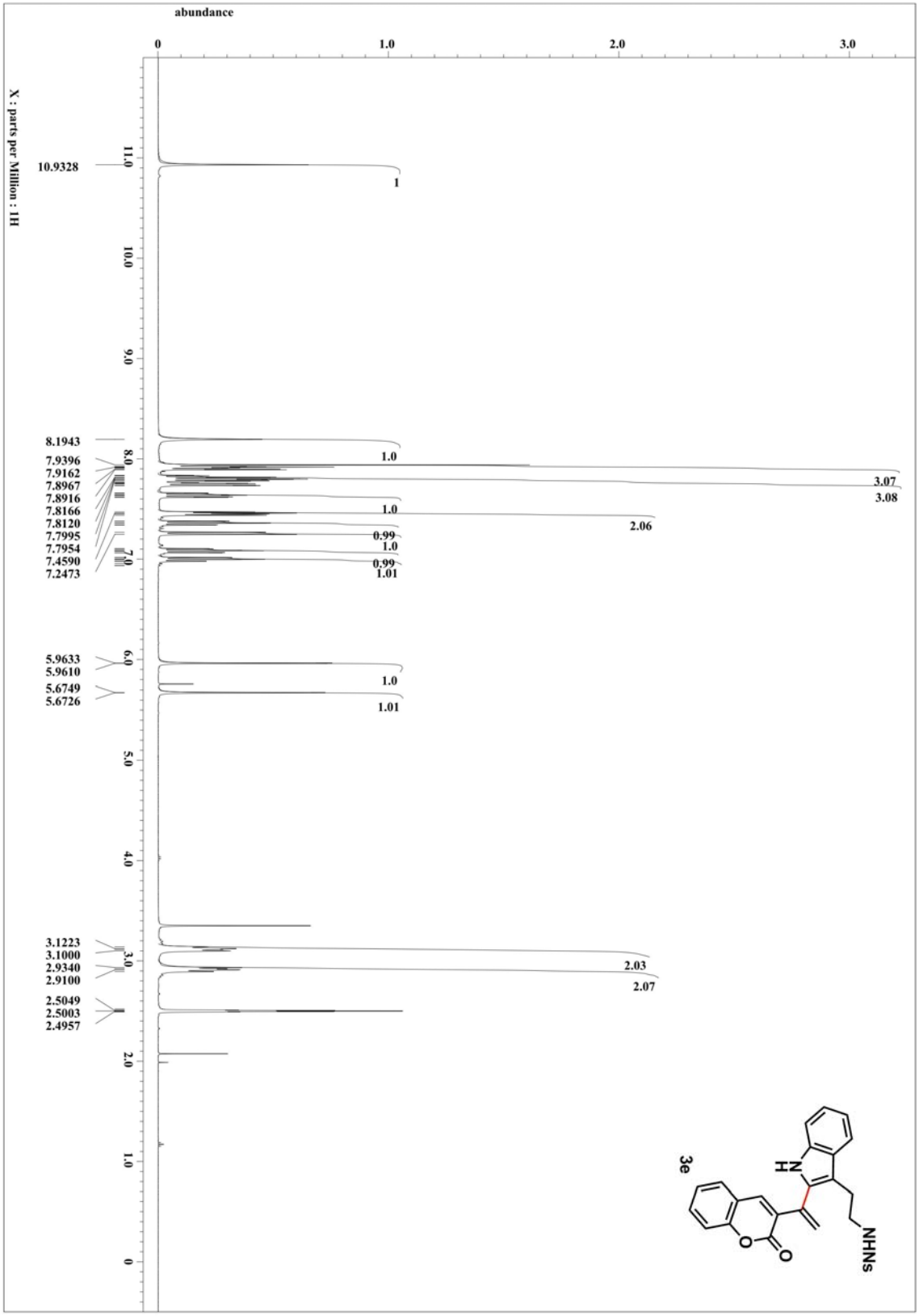


Figure S9. A ^{1}H-NMR spectrum of **3e** in $(CD_3)_2SO$

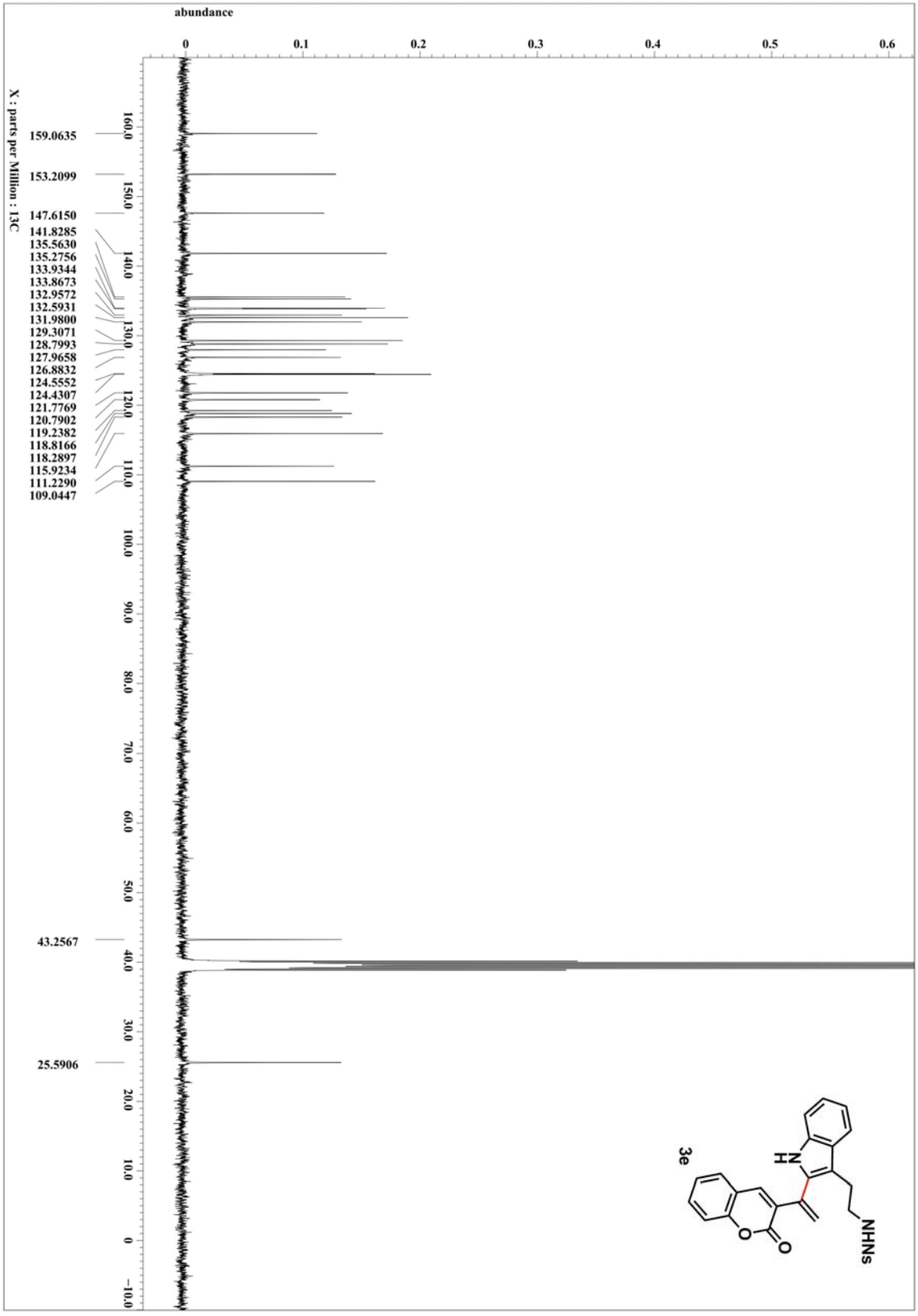


Figure S10. A ^{13}C-NMR spectrum of **3e** in $(CD_3)_2SO$

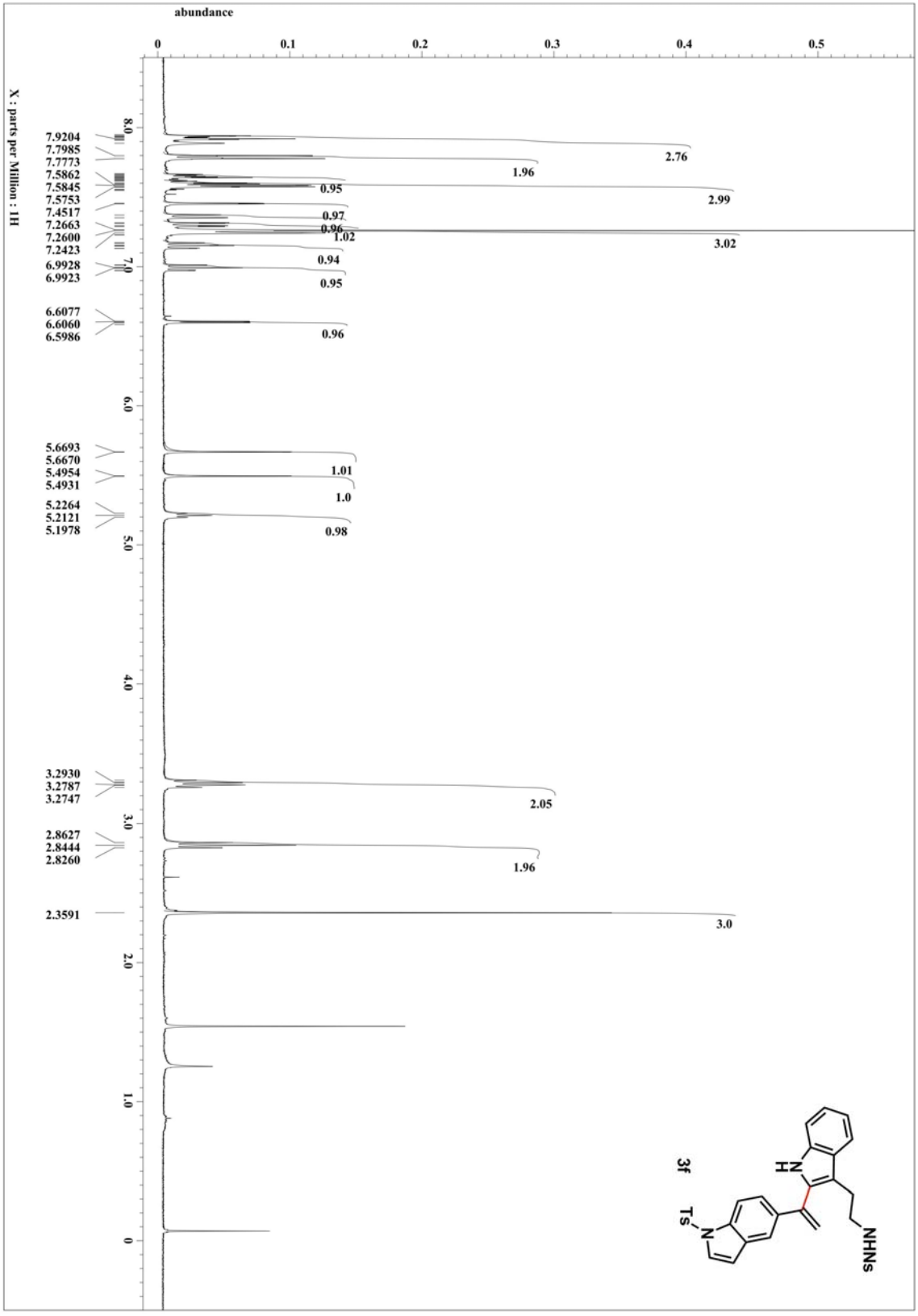


Figure S11. A ^{1}H-NMR spectrum of **3f** in $CDCl_3$

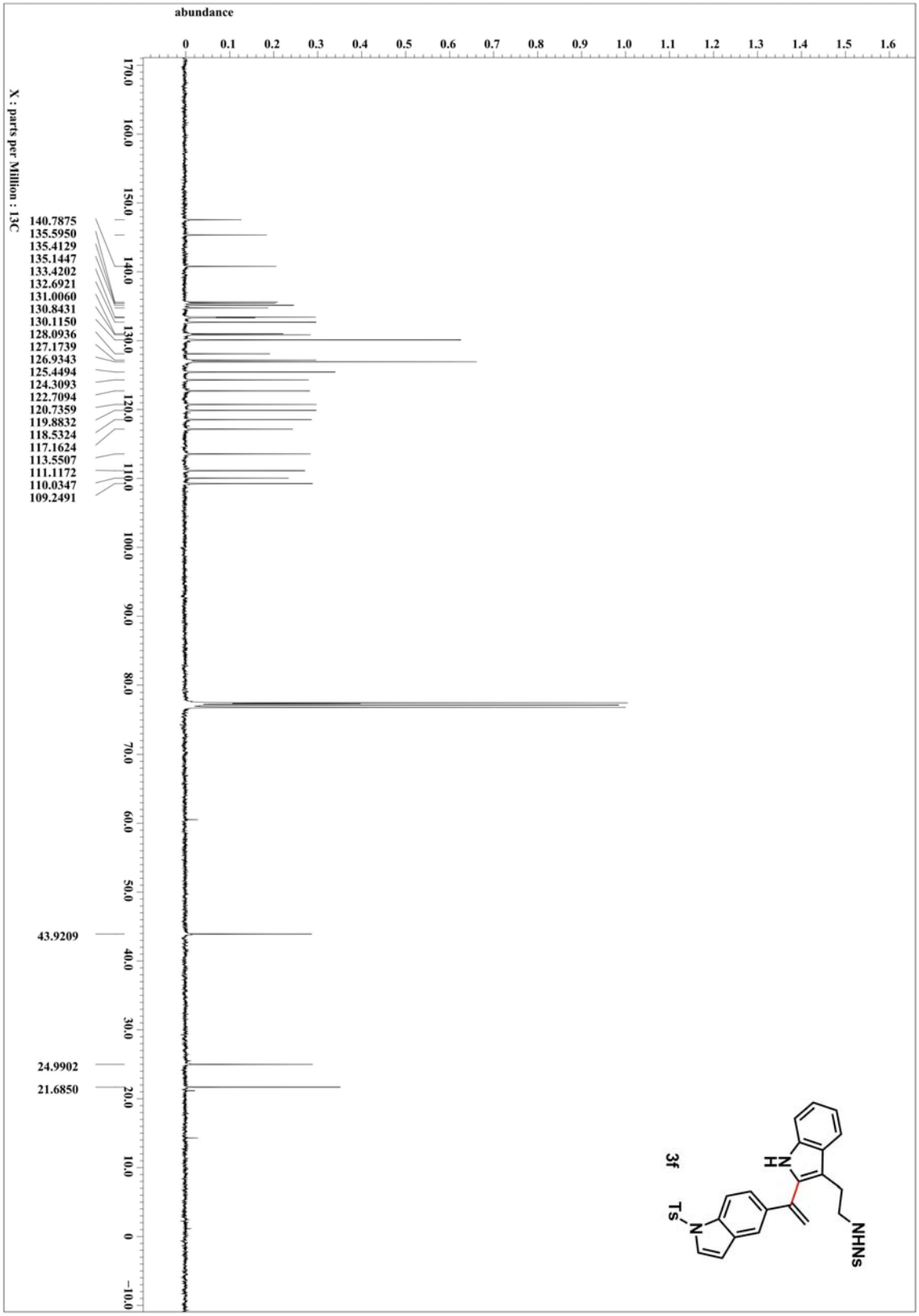


Figure S12. A ^{13}C-NMR spectrum of **3f** in $CDCl_3$

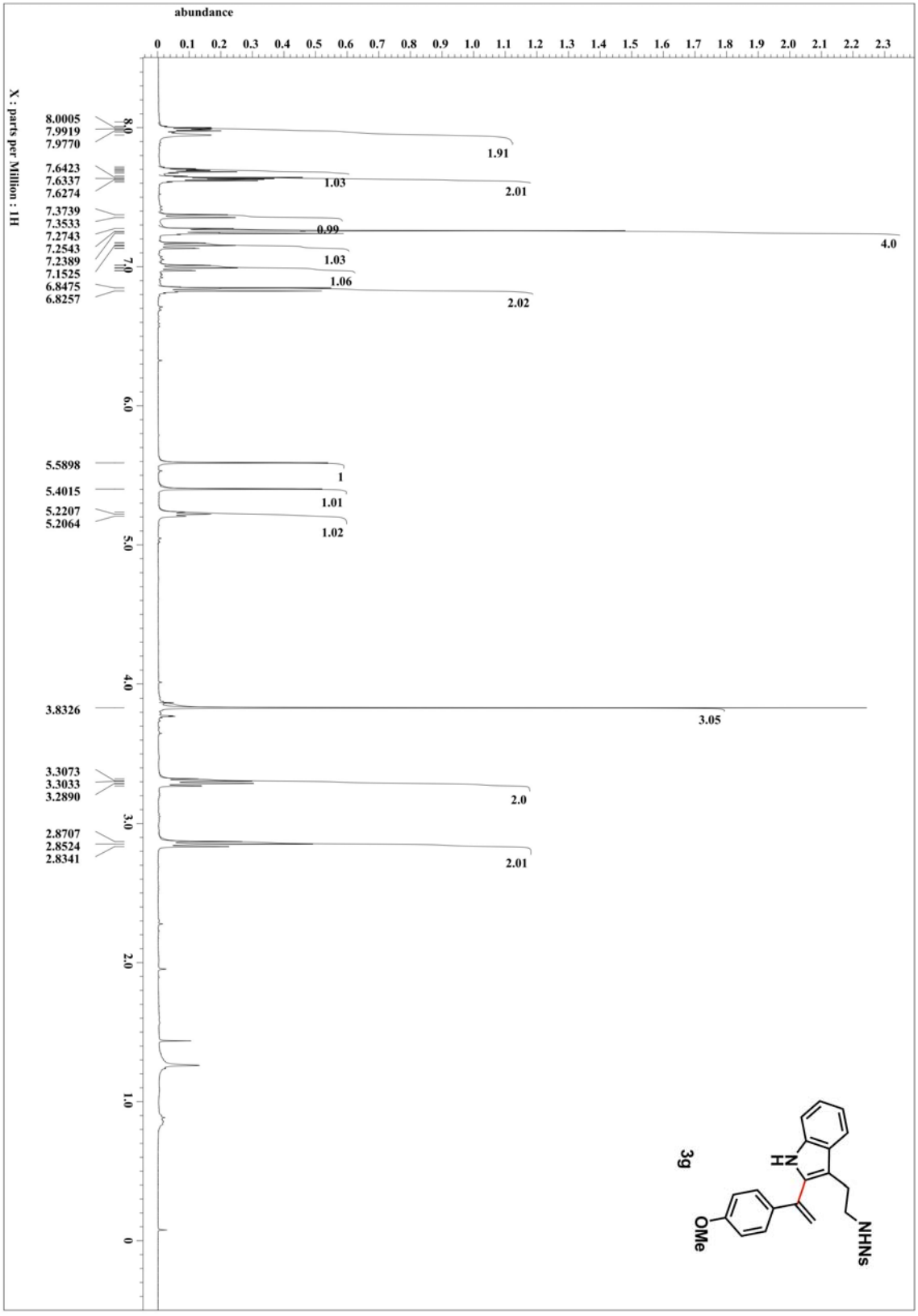


Figure S13. A ^{1}H-NMR spectrum of **3g** in $CDCl_3$

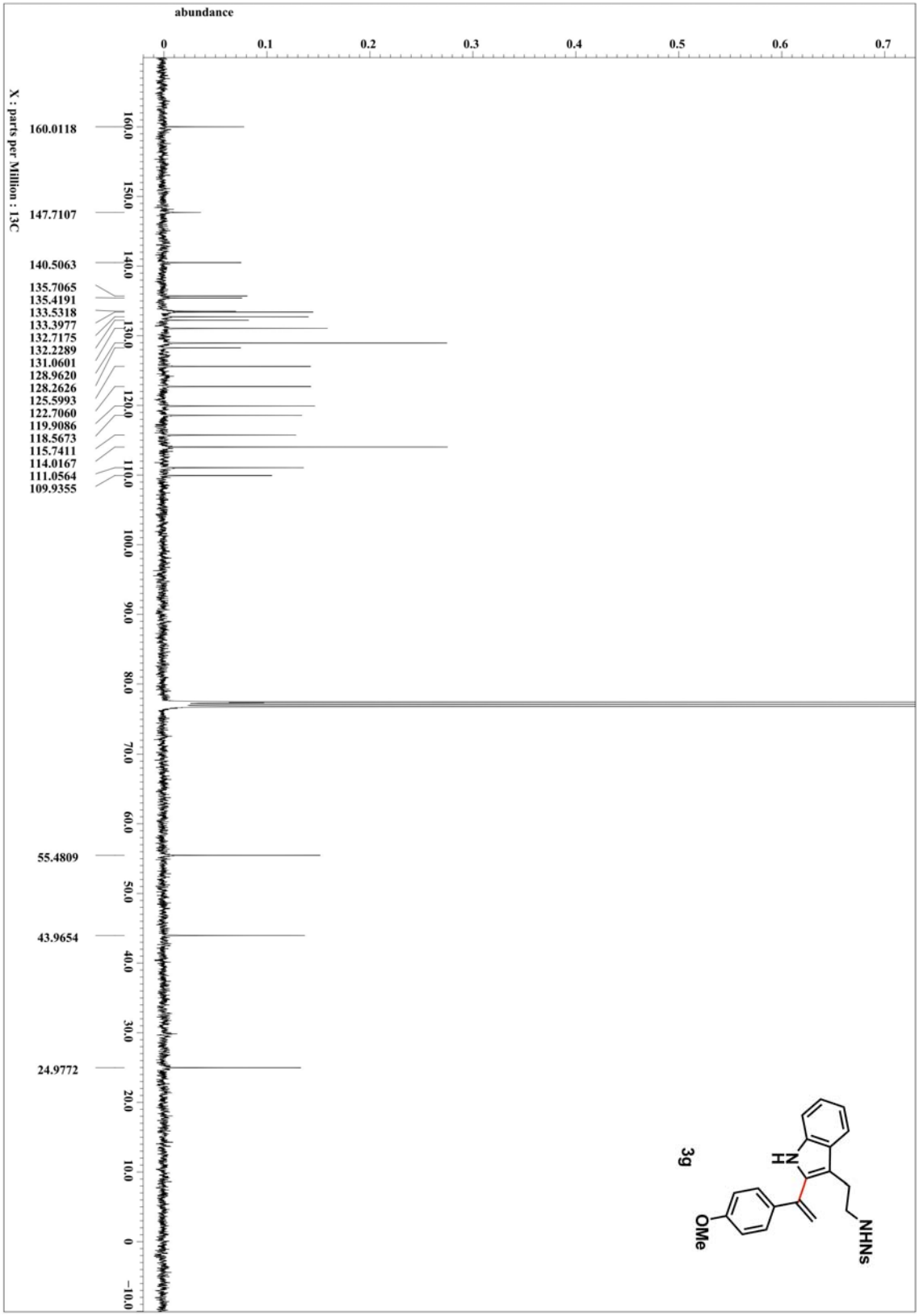


Figure S14. A ^{13}C-NMR spectrum of **3g** in $CDCl_3$

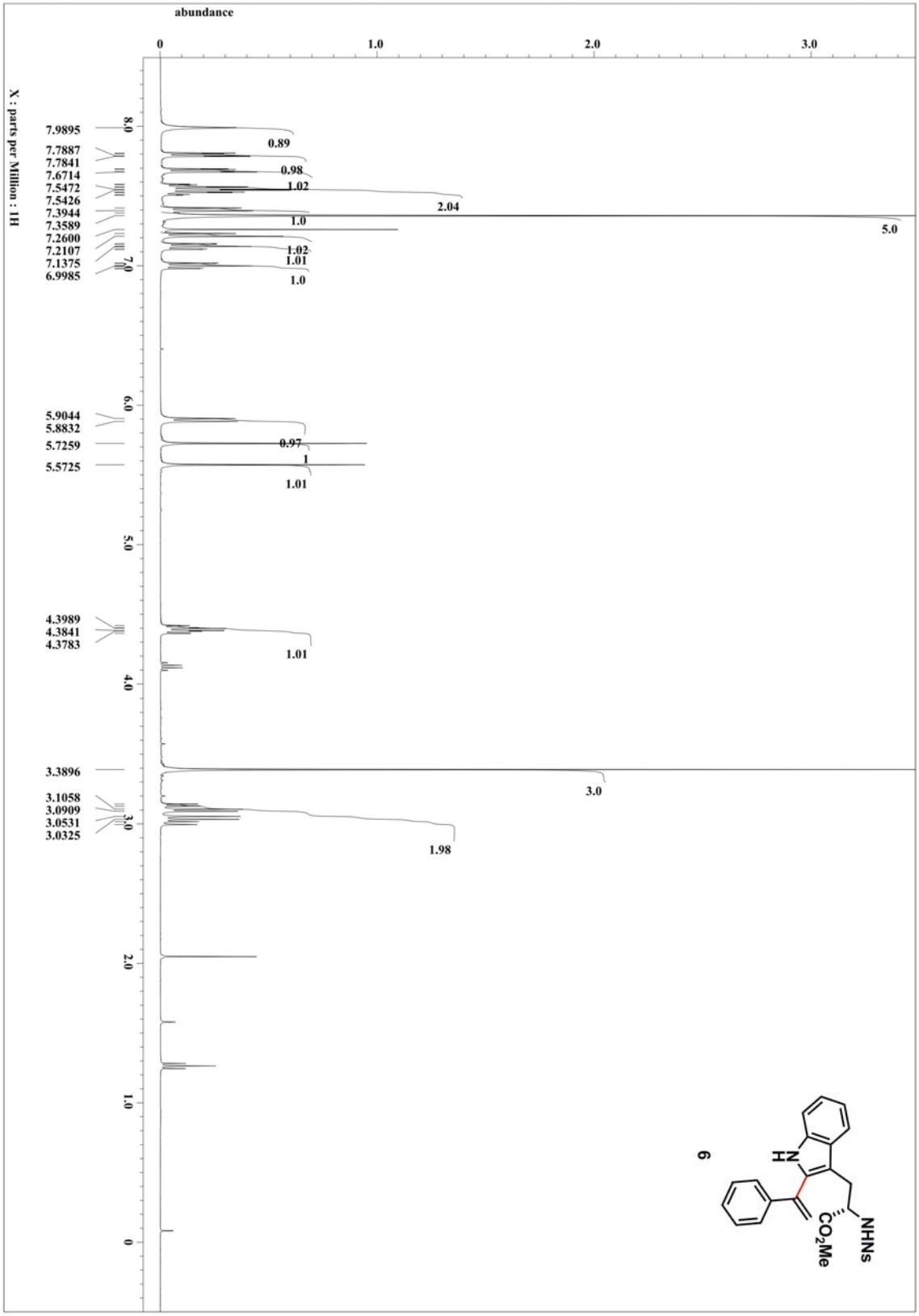


Figure S15. A ^{1}H-NMR spectrum of **6** in $CDCl_3$

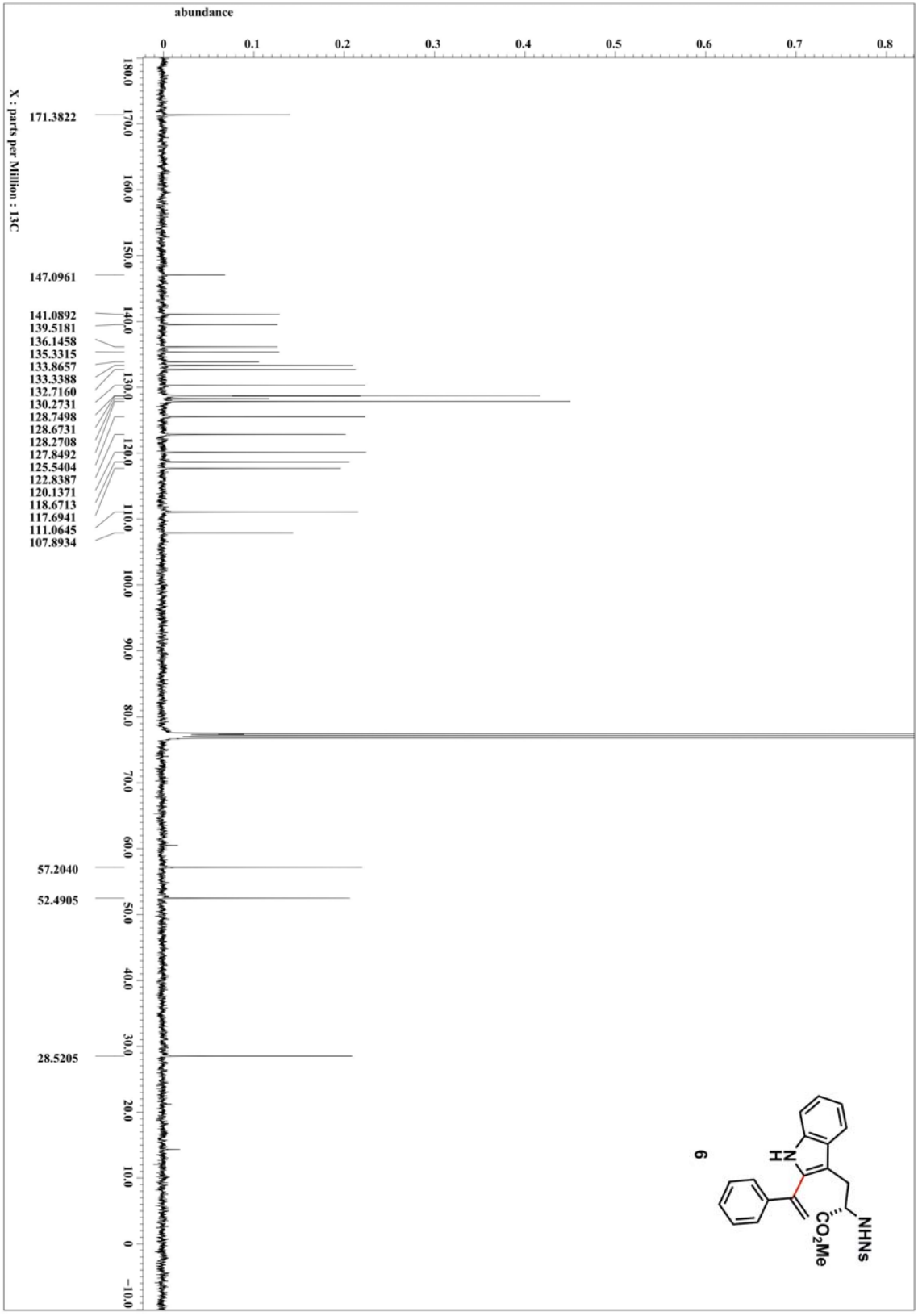


Figure S16. A ^{13}C-NMR spectrum of **6** in $CDCl_3$

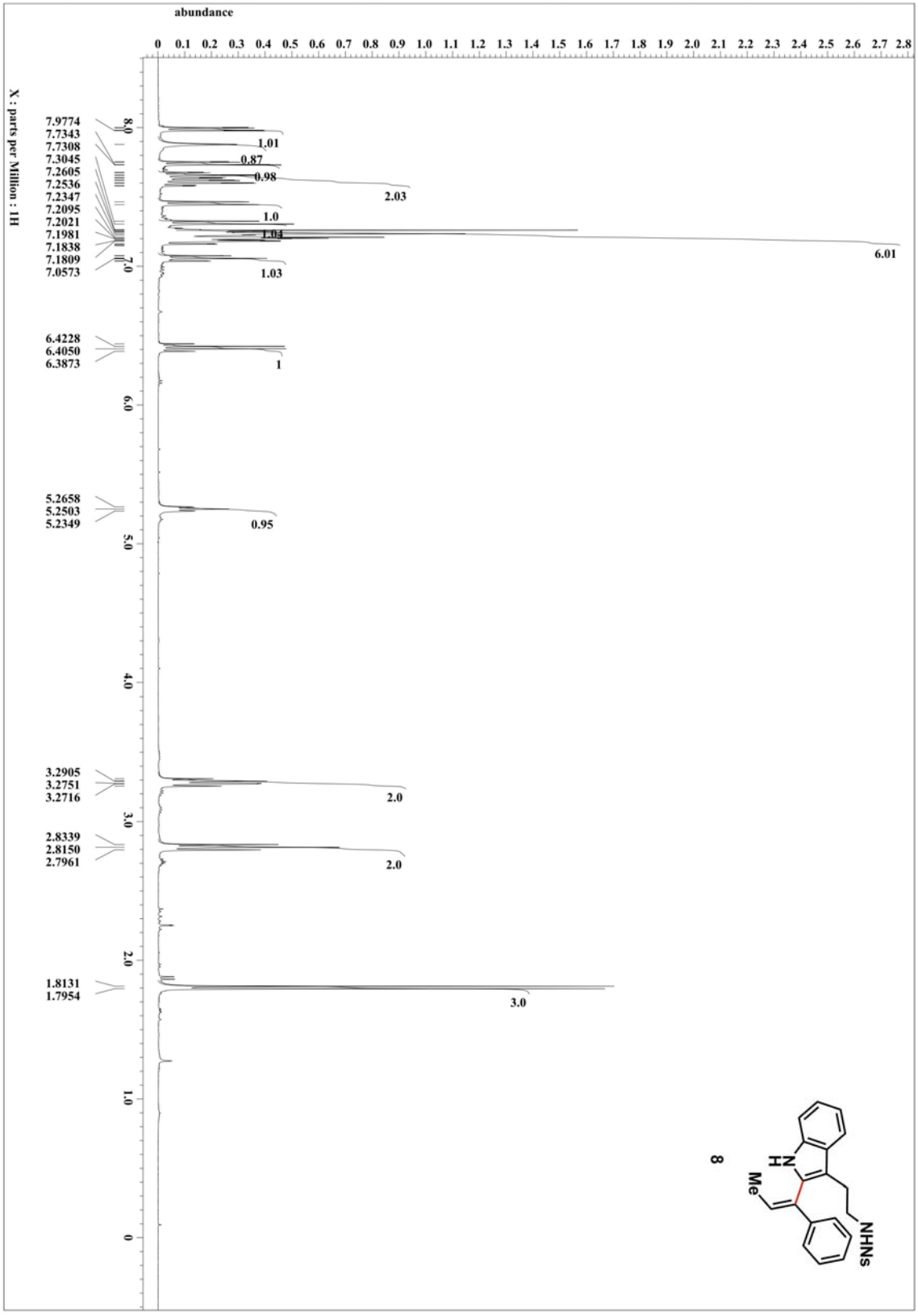


Figure S17. A ^{1}H-NMR spectrum of **8** in $CDCl_3$

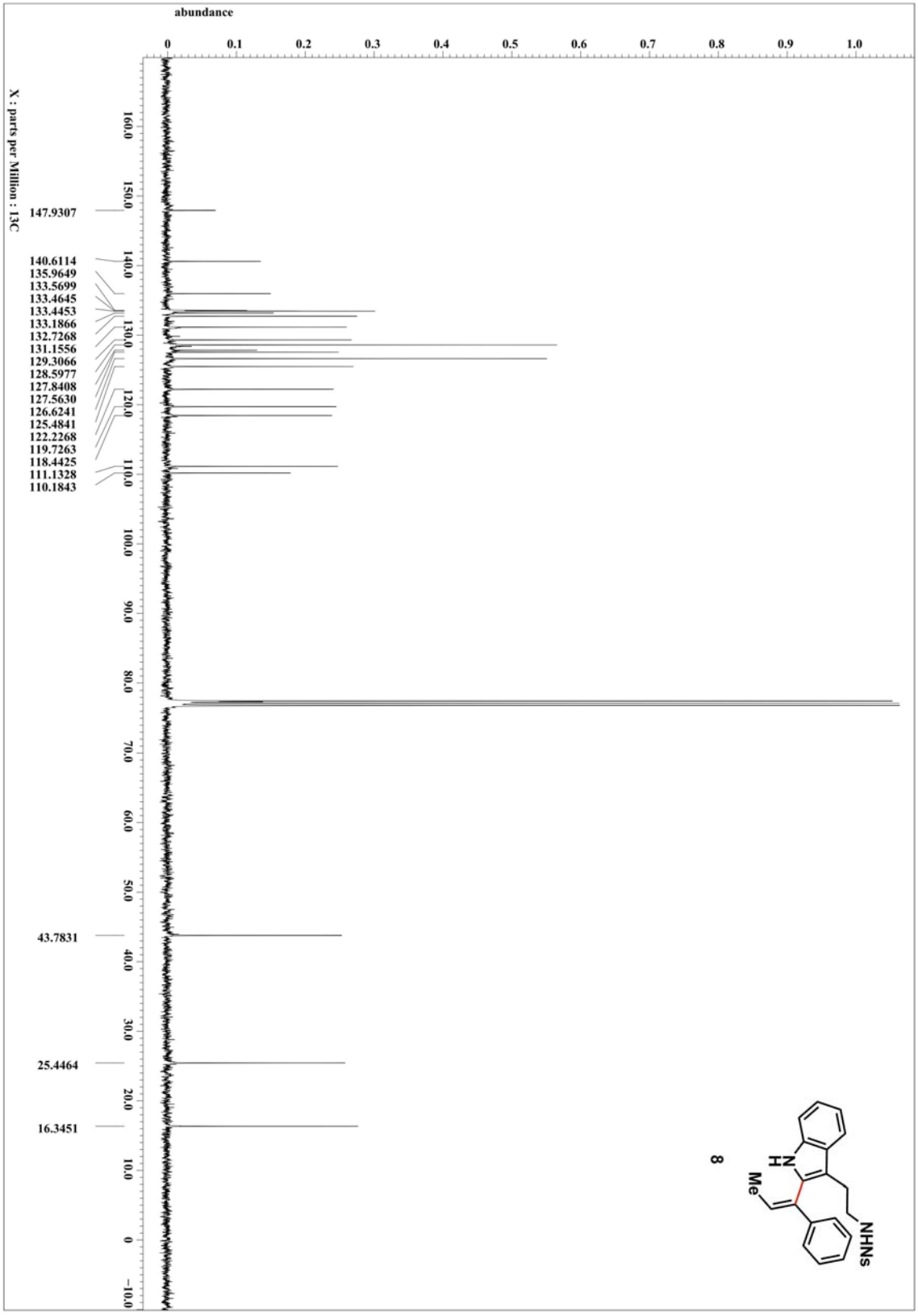


Figure S18. A ^{13}C-NMR spectrum of **8** in $CDCl_3$

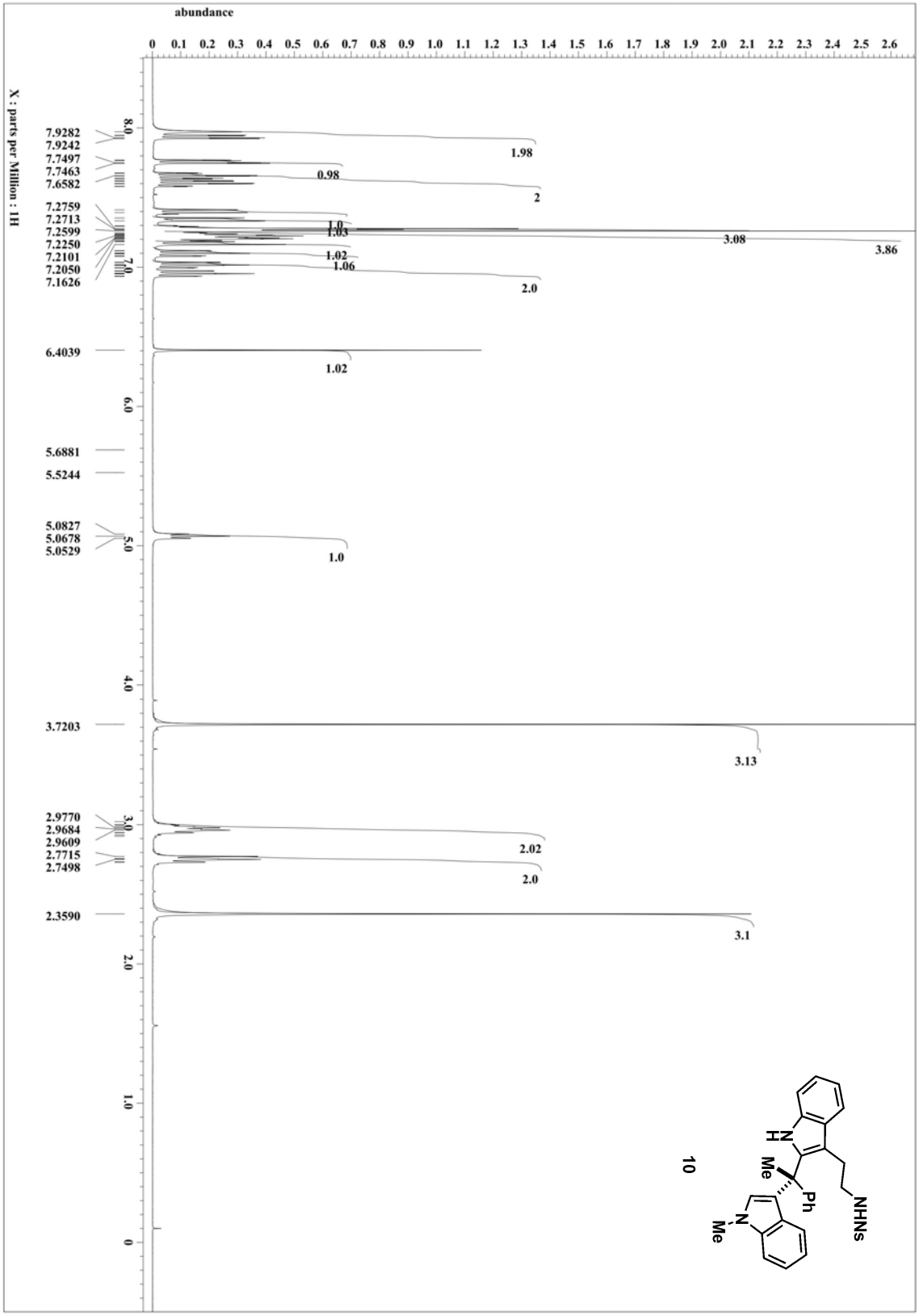


Figure S19. A ^{1}H-NMR spectrum of **10** in $CDCl_3$

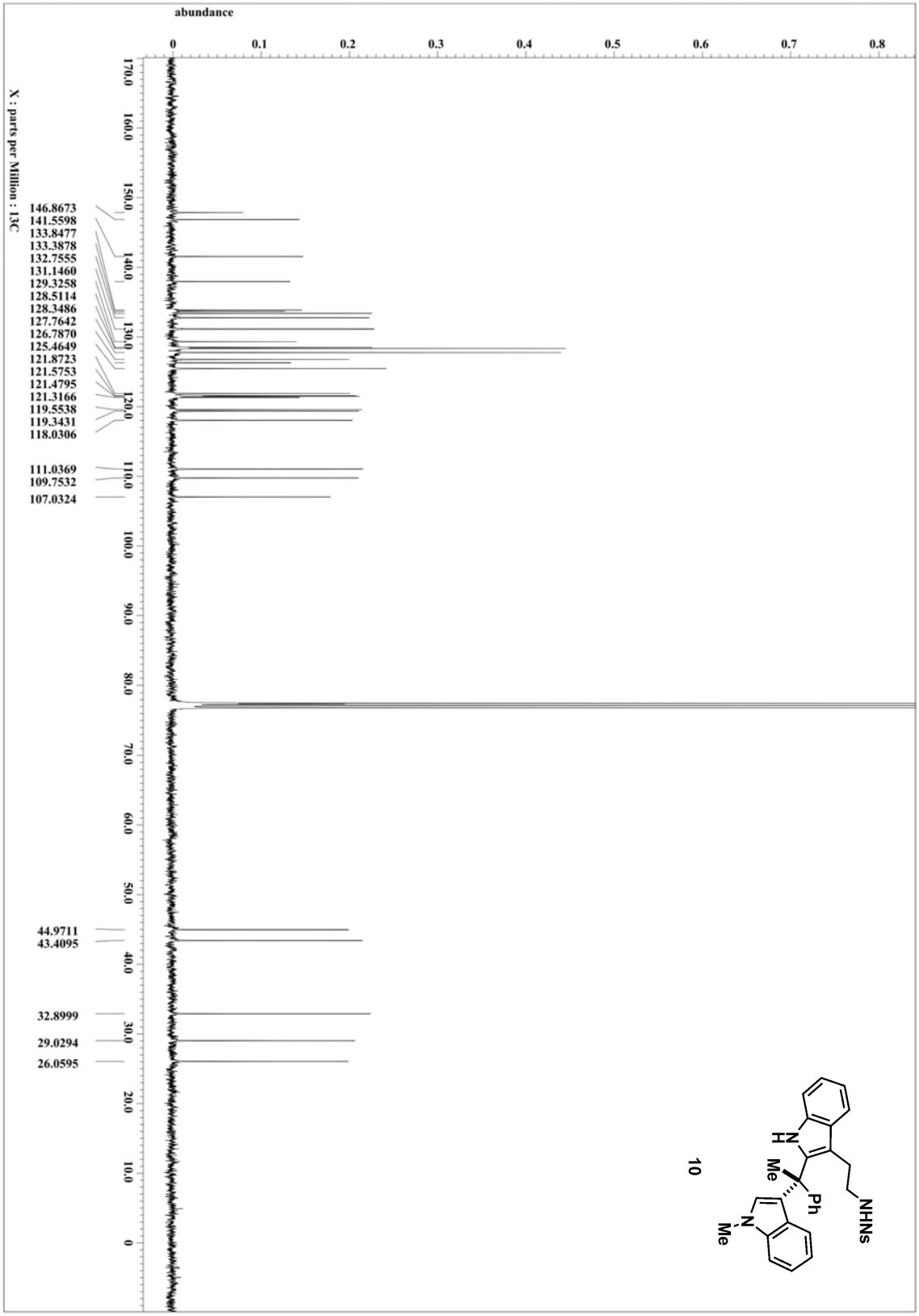


Figure S20. A ^{13}C-NMR spectrum of **10** in $CDCl_3$

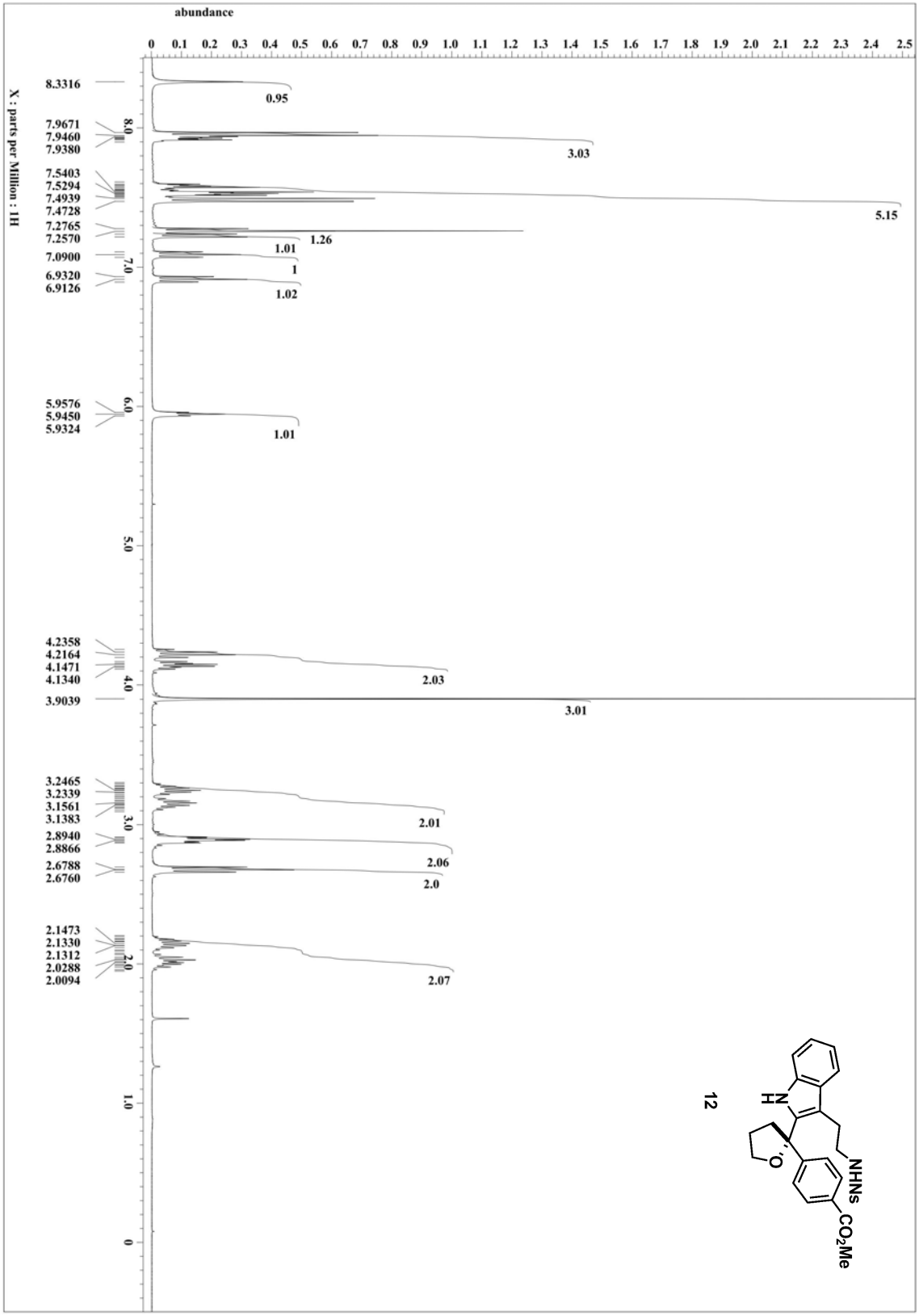


Figure S21. A ^{1}H-NMR spectrum of **12** in $CDCl_3$

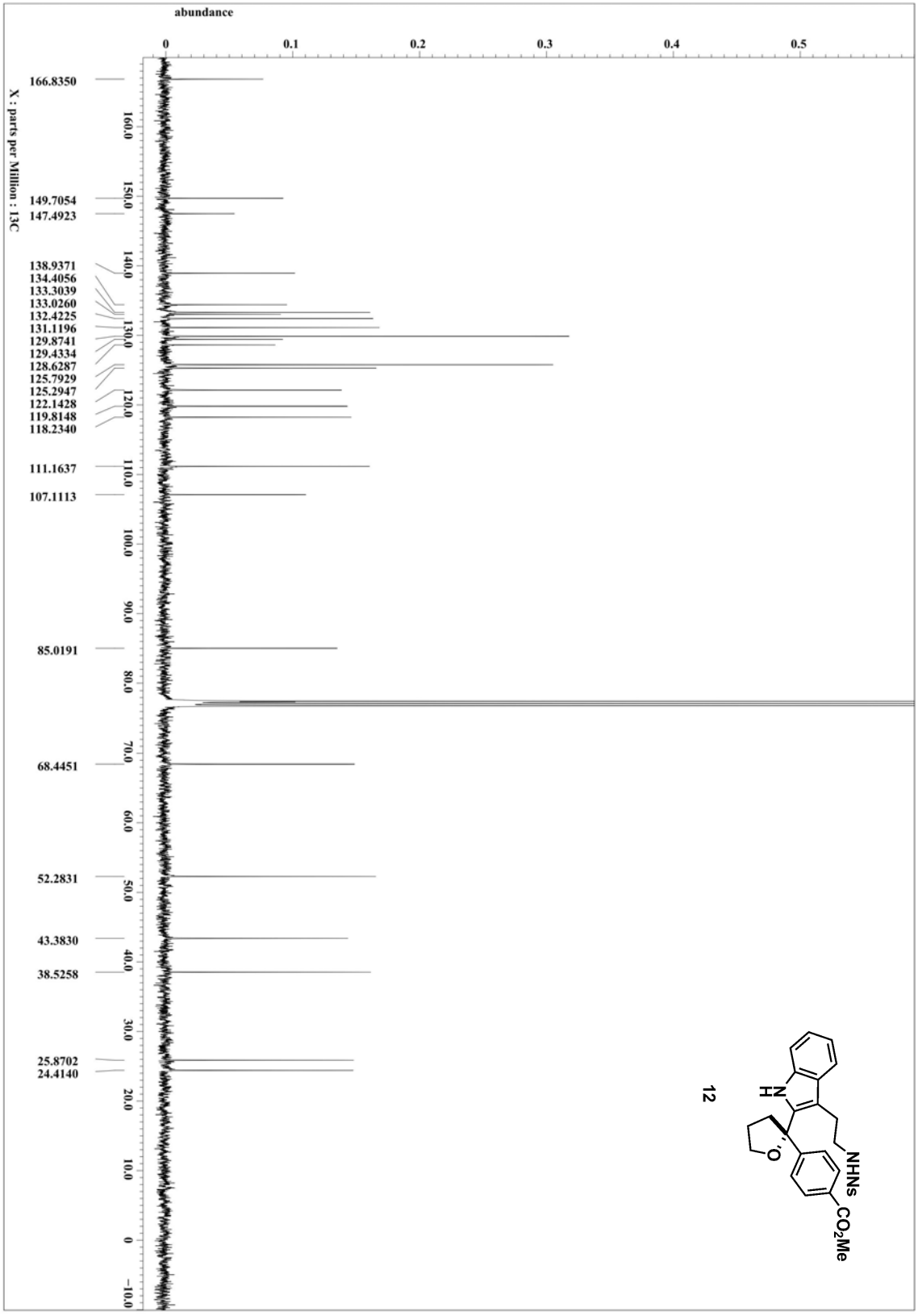


Figure S22. A ^{13}C-NMR spectrum of **12** in $CDCl_3$

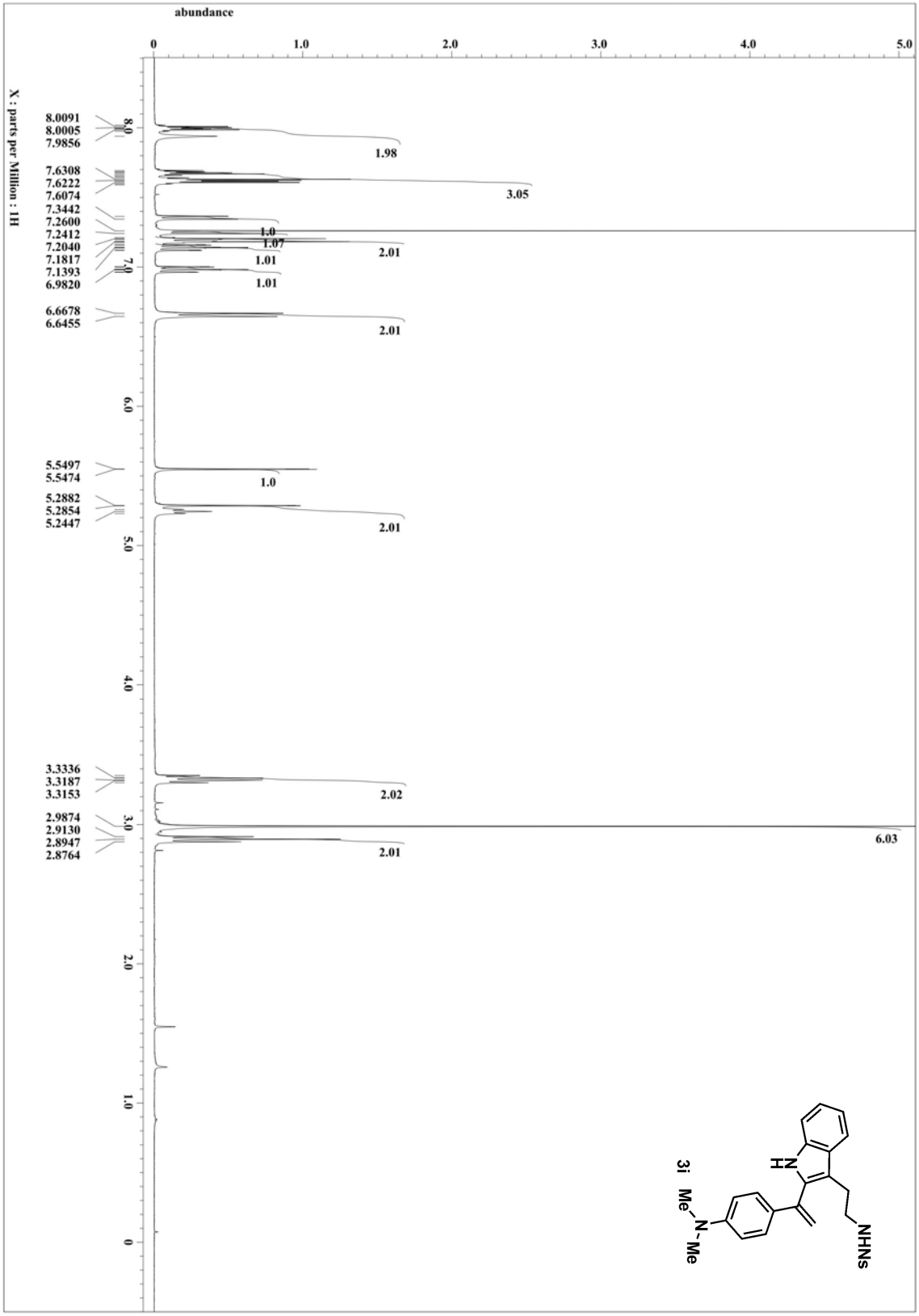


Figure S23. A ^{1}H-NMR spectrum of **3i** in $CDCl_3$

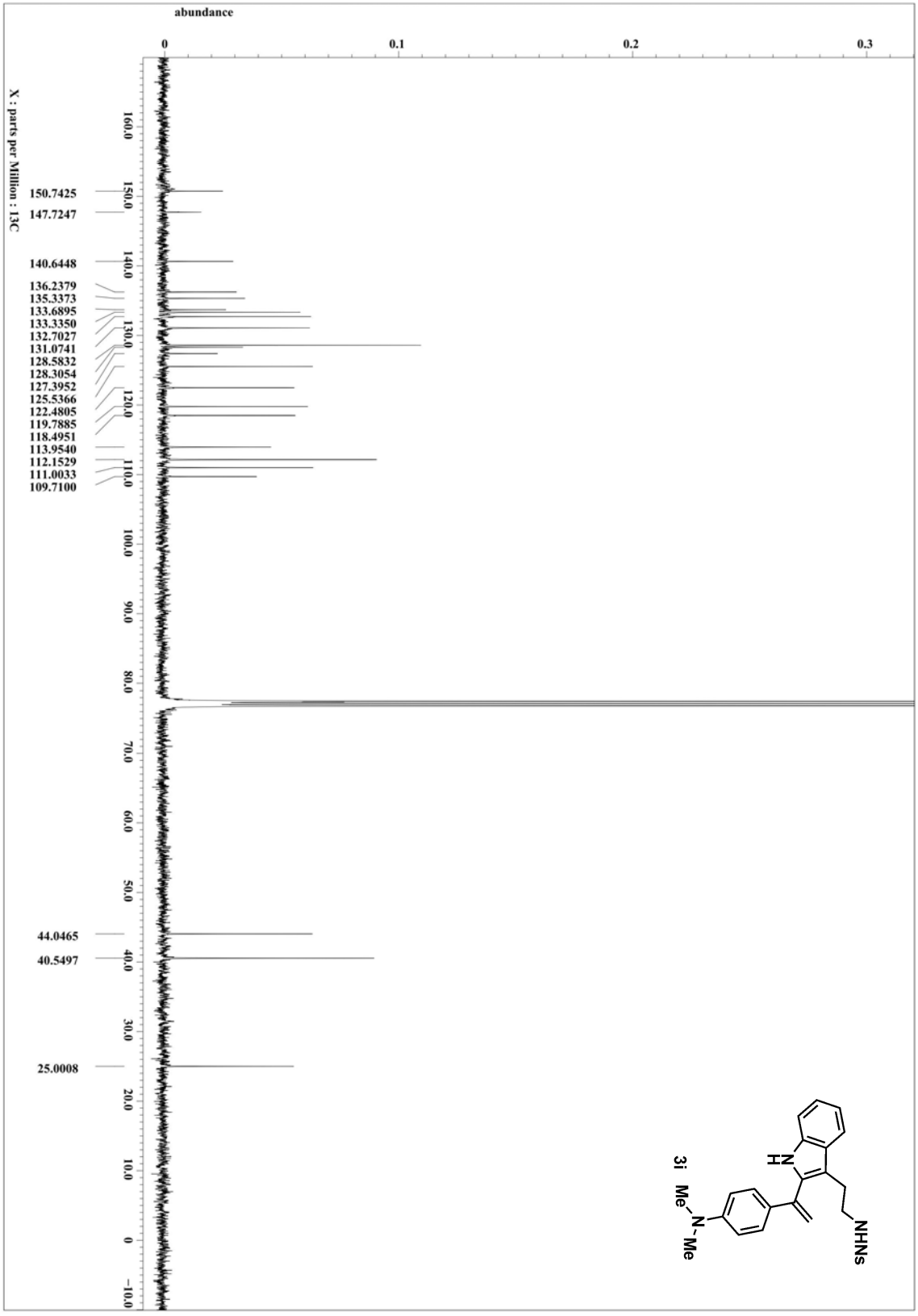


Figure S24. A ^{13}C-NMR spectrum of **3i** in $CDCl_3$

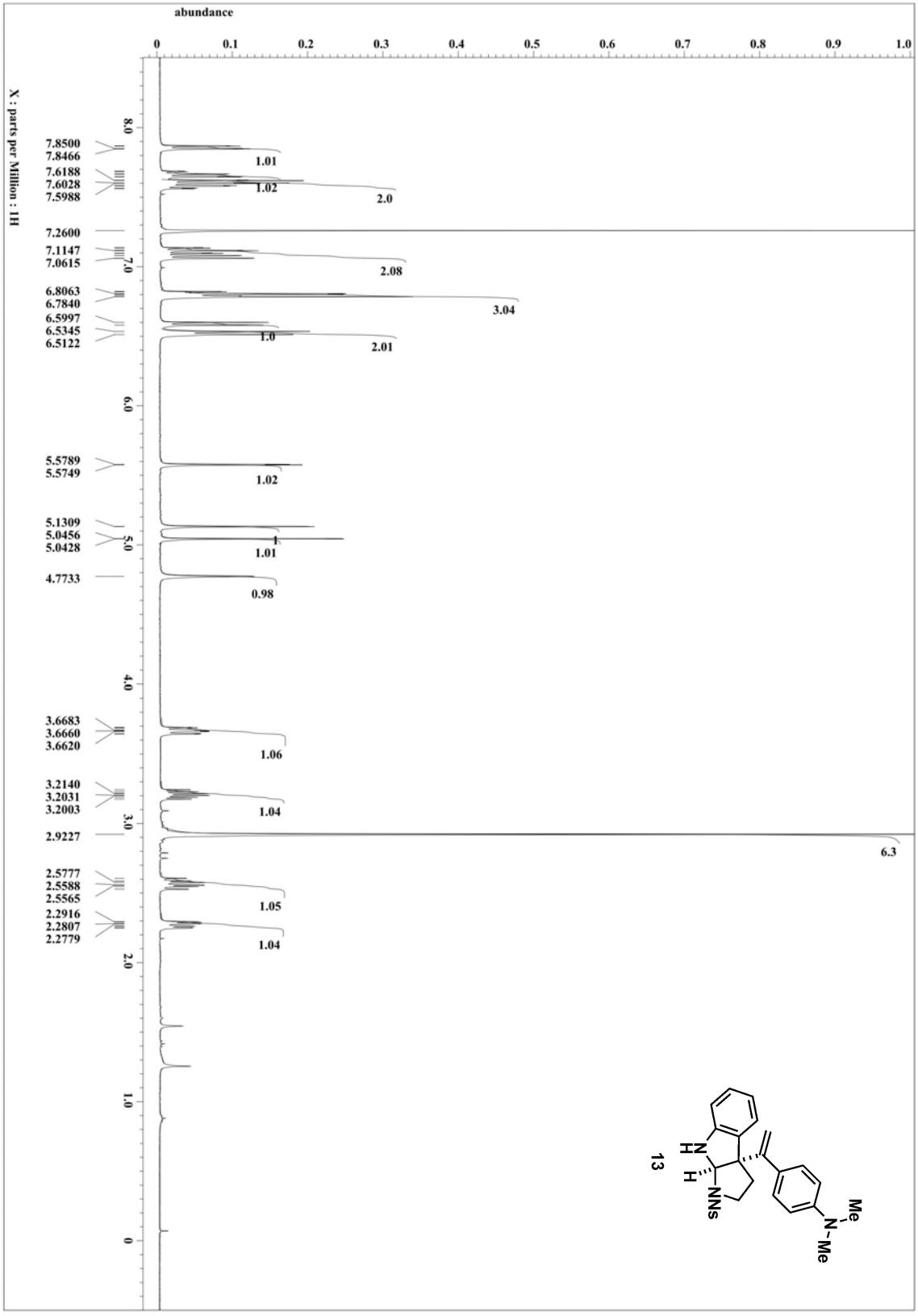


Figure S25. A ^{1}H-NMR spectrum of **13** in $CDCl_3$

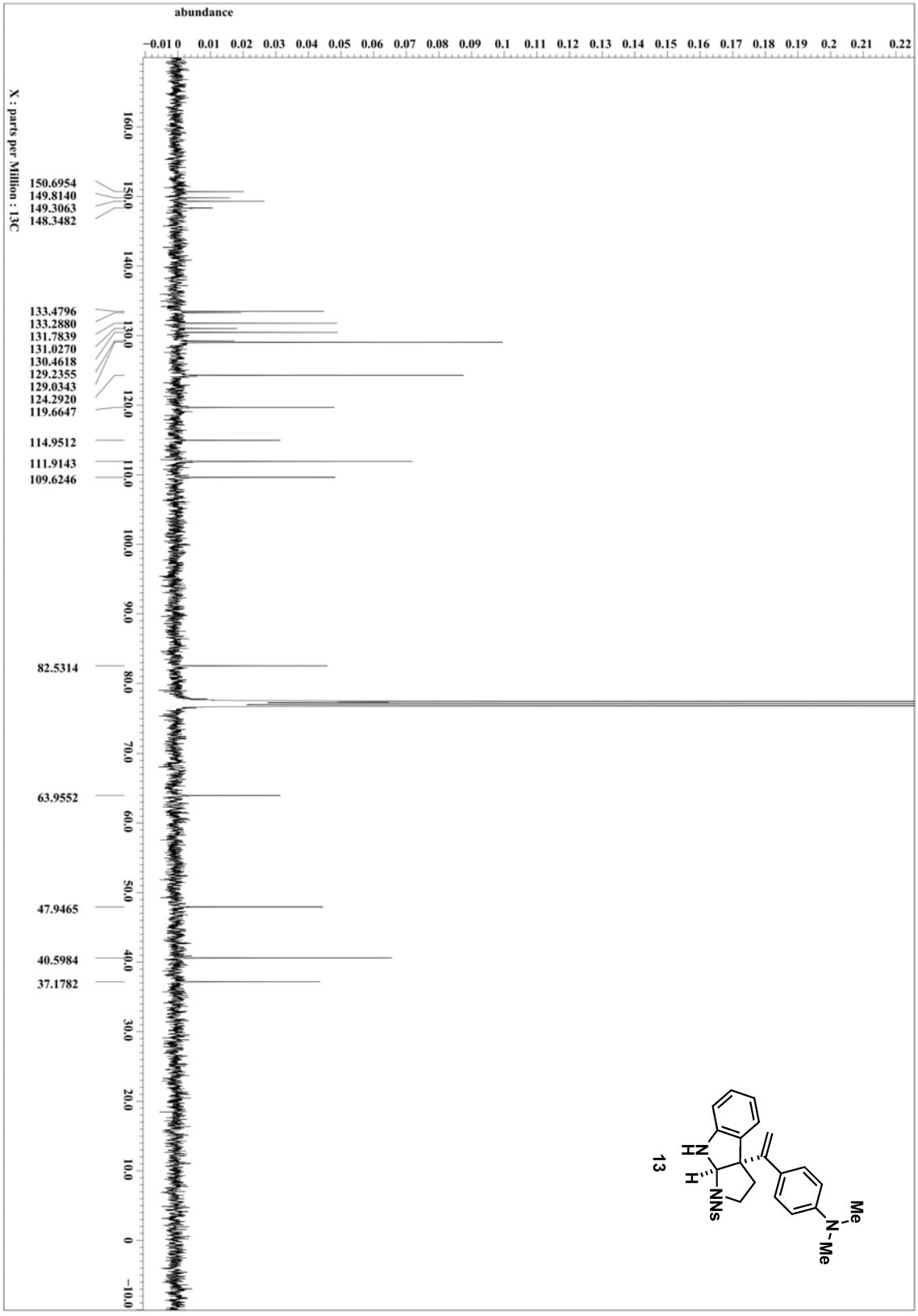


Figure S26. A ^{13}C-NMR spectrum of **13** in $CDCl_3$

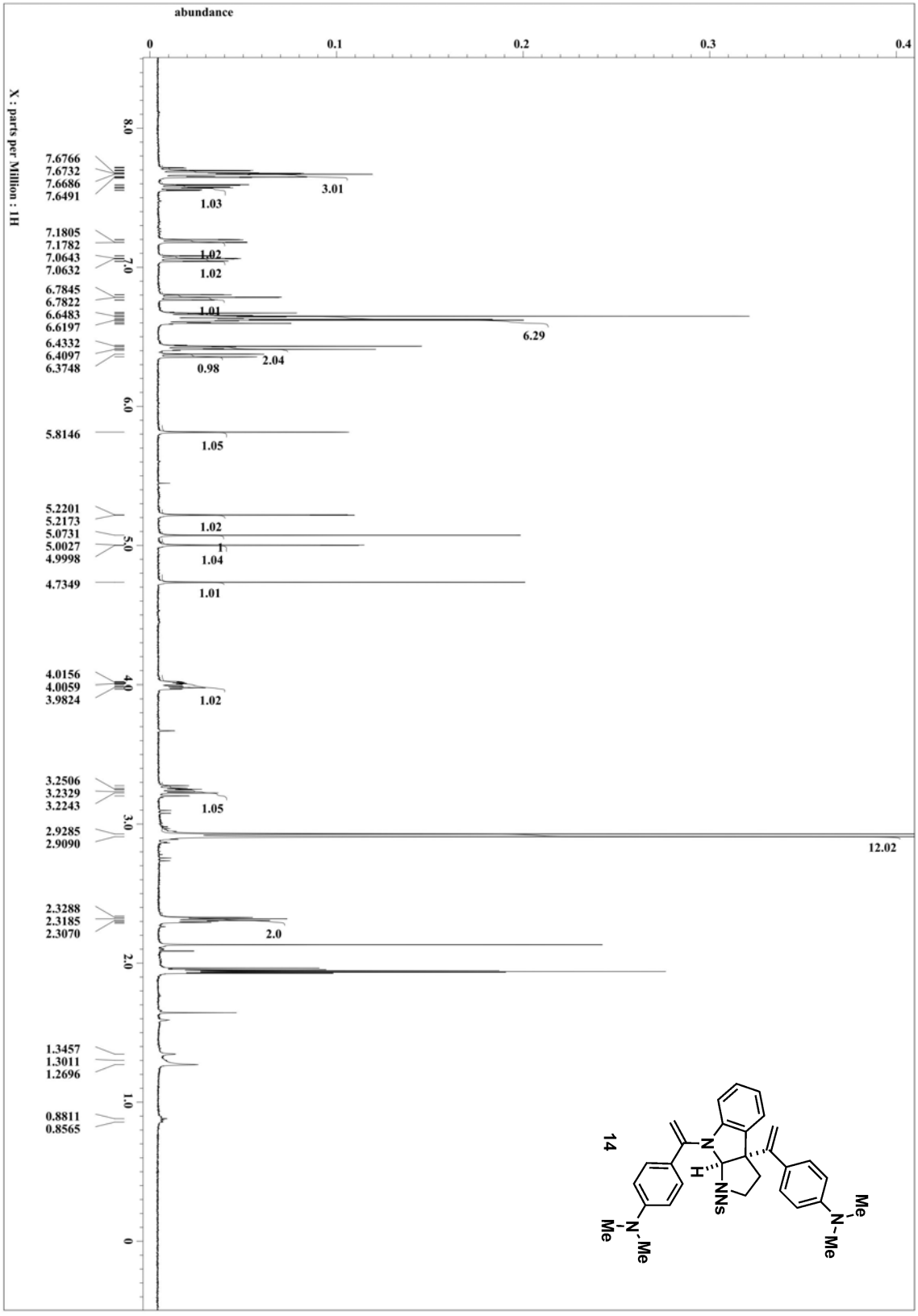


Figure S27. A ^{1}H-NMR spectrum of **14** in CD_3CN

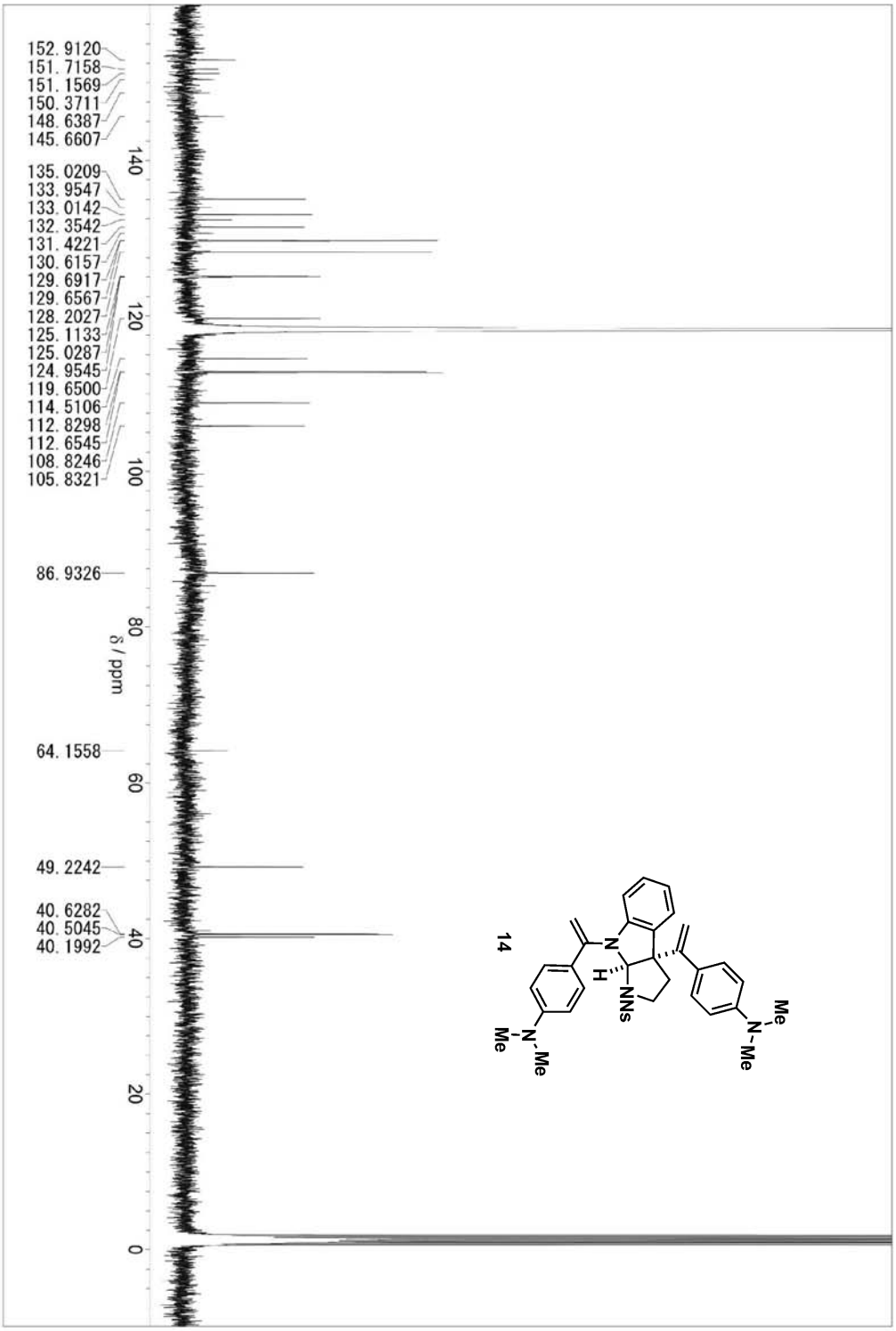


Figure S28. A ^{13}C-NMR spectrum of **14** in CD_3CN

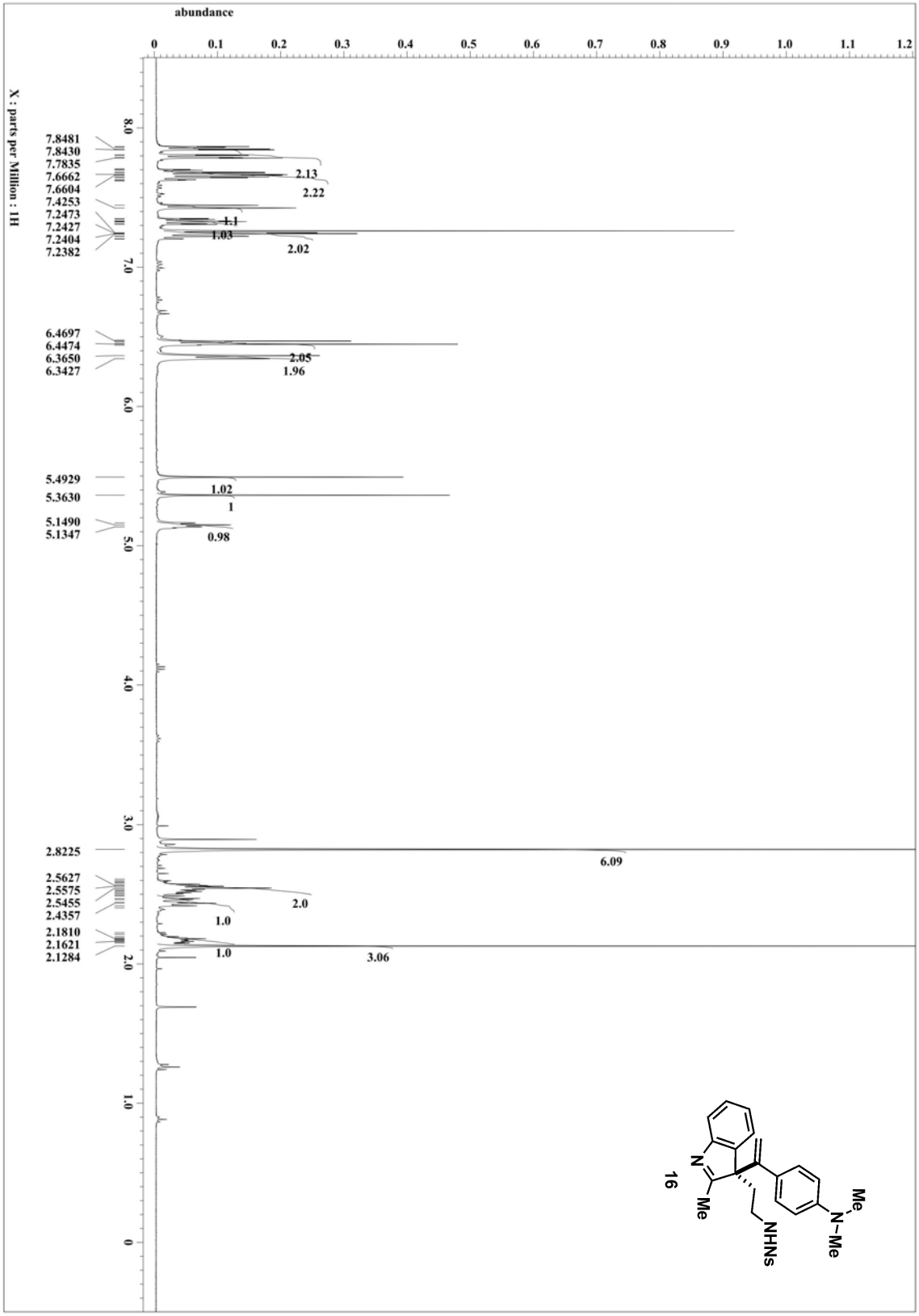


Figure S29. A ^{1}H-NMR spectrum of **16** in $CDCl_3$

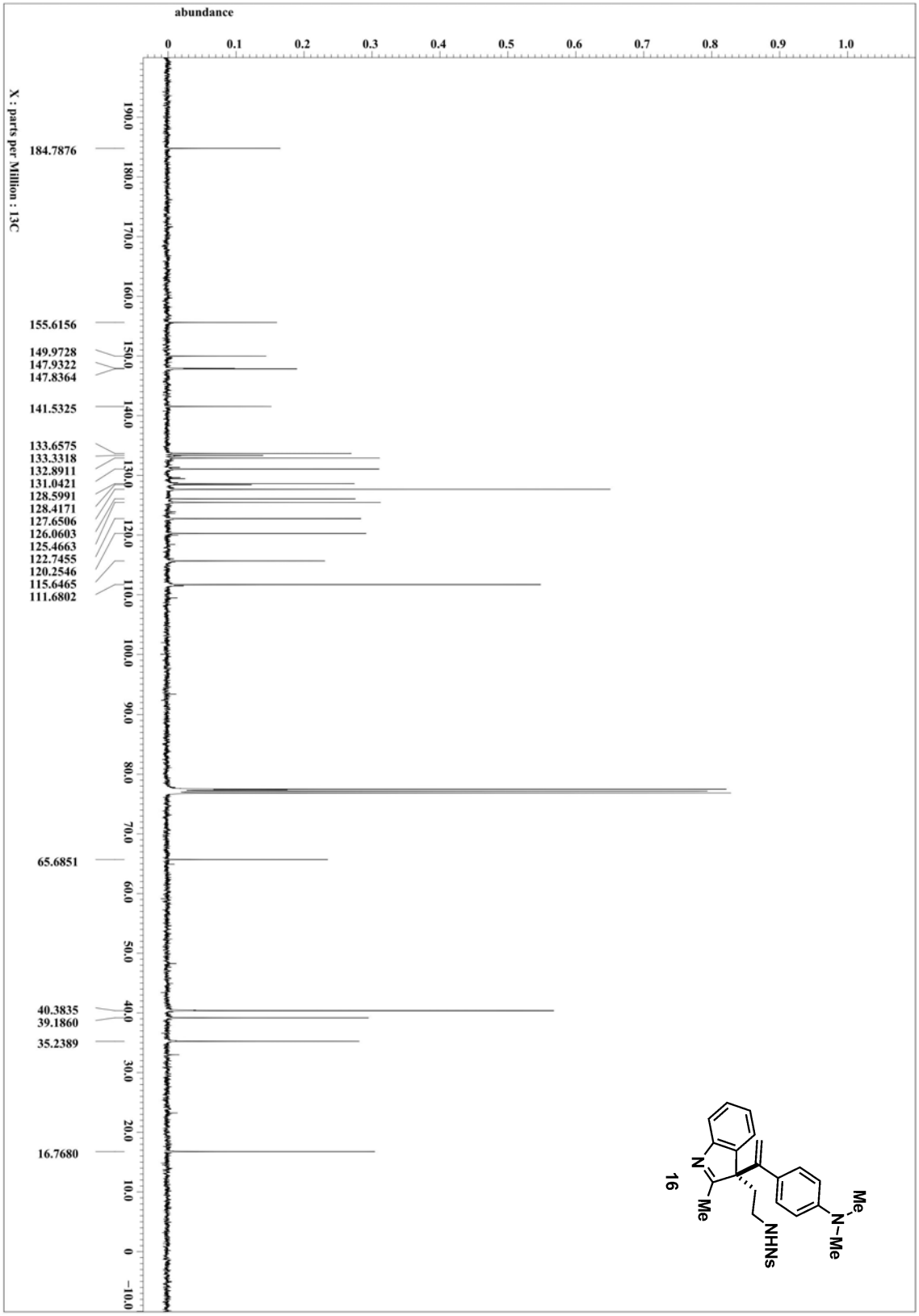


Figure S30. A ^{13}C-NMR spectrum of **16** in $CDCl_3$

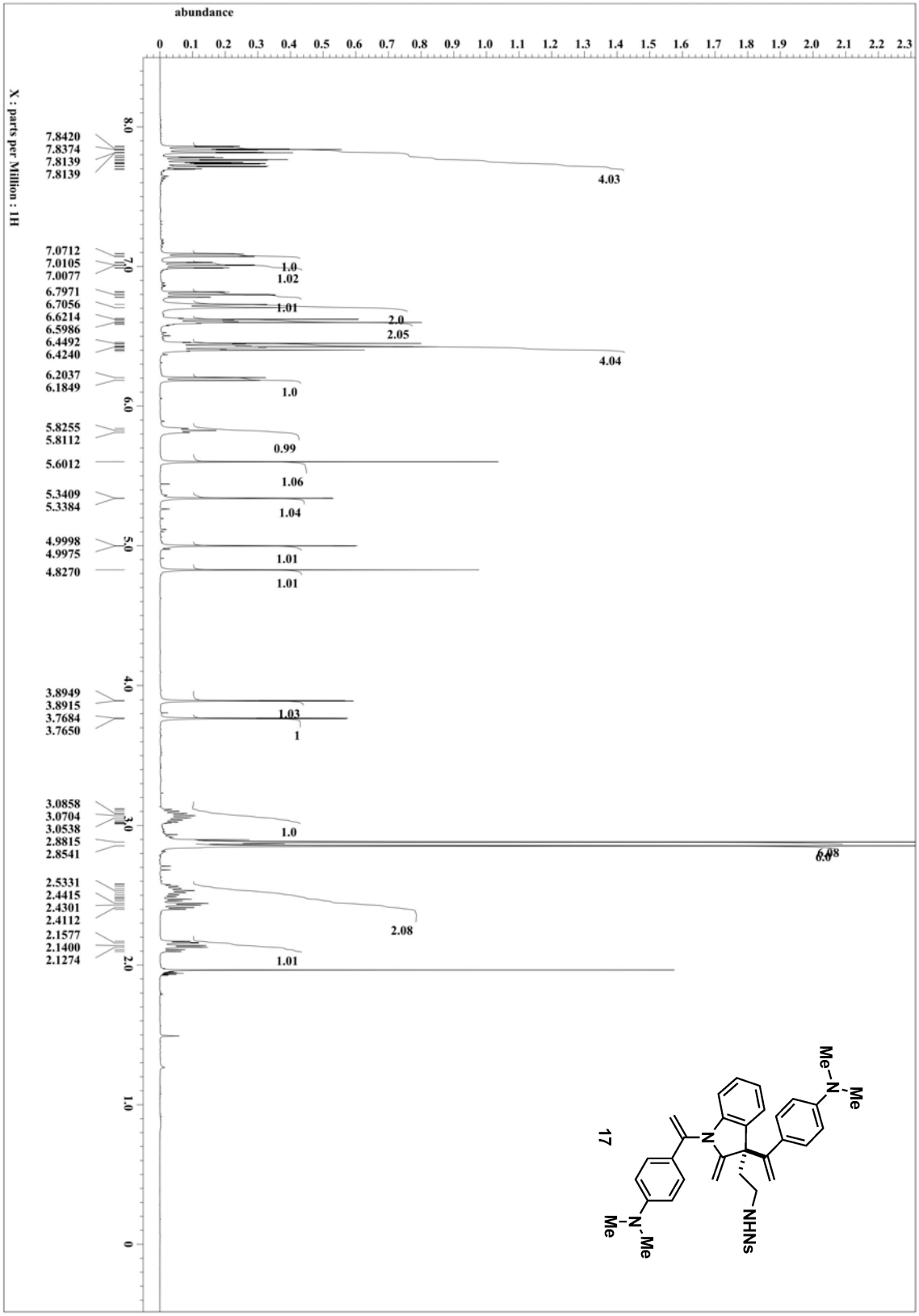


Figure S31. A ^{1}H-NMR spectrum of **17** in CD_3CN

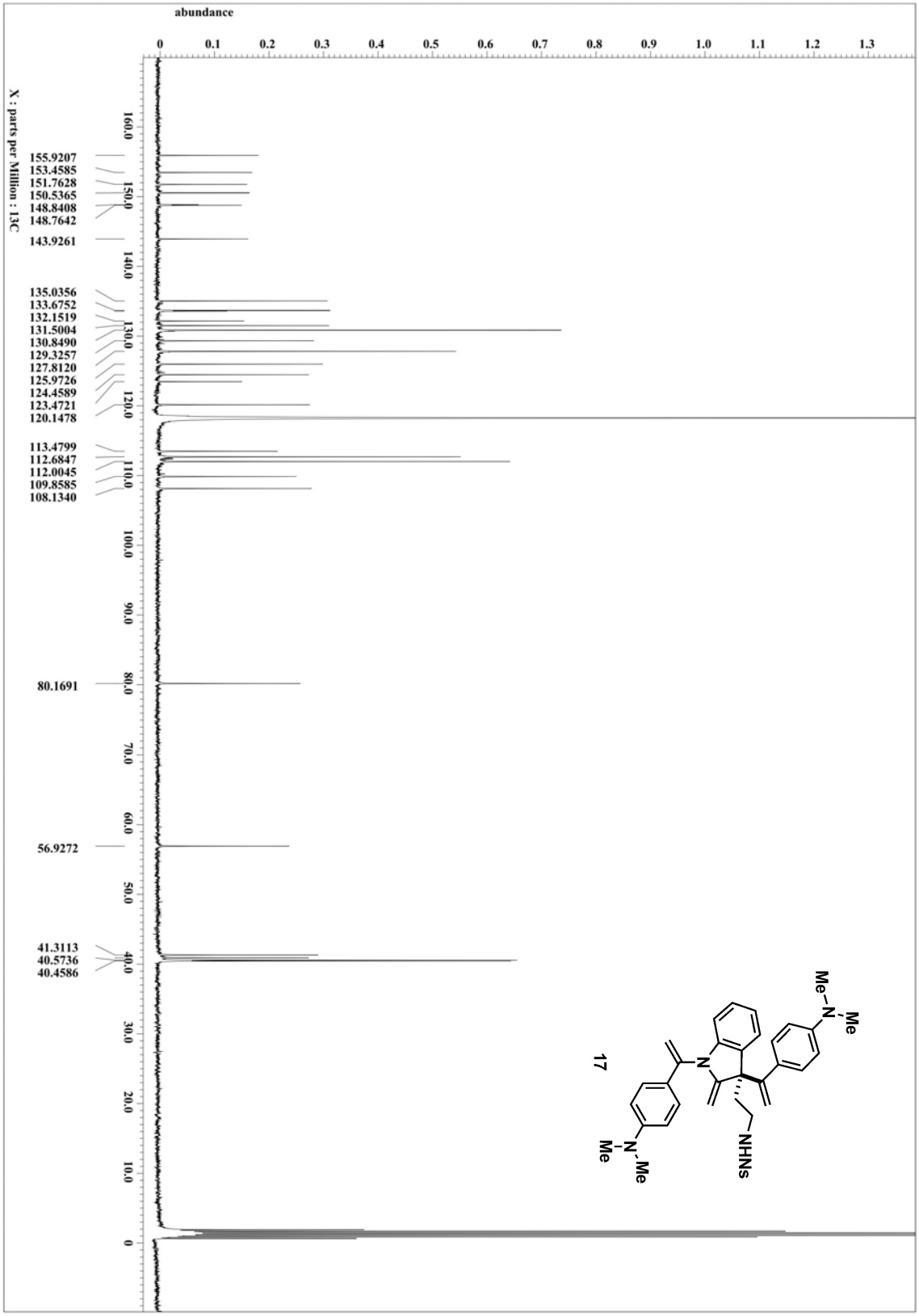


Figure S32. A ^{1}H-NMR spectrum of **17** in CD_3CN

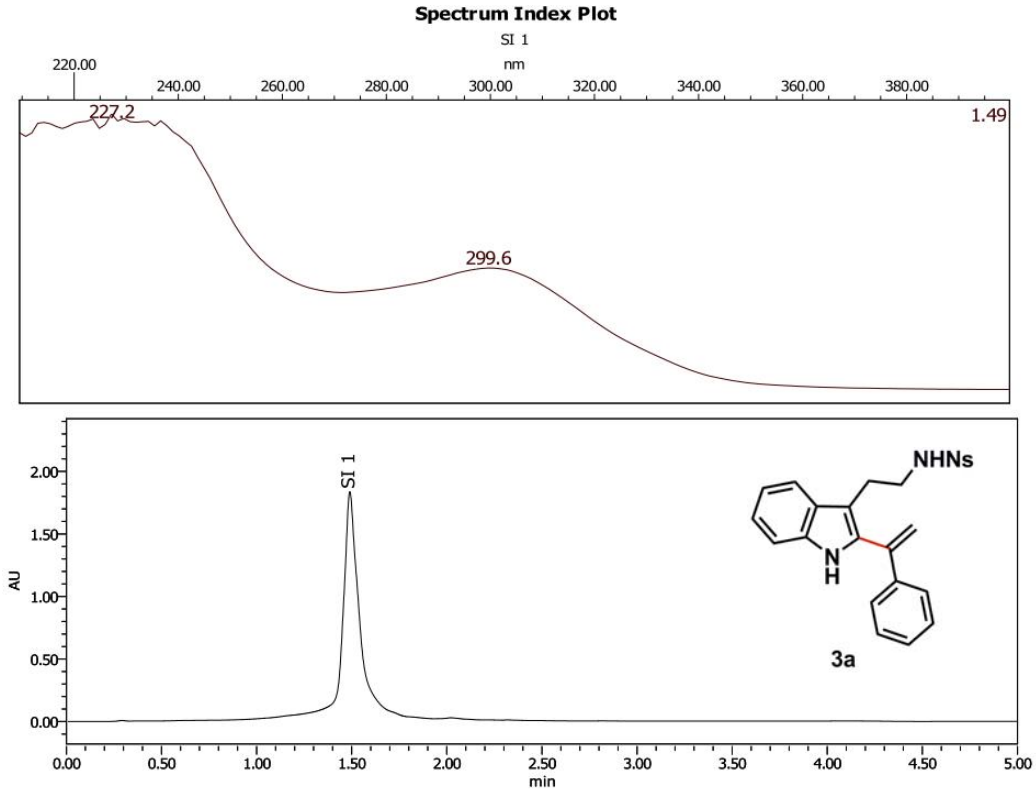


Figure S33. UPLC chromatograph and UV spectra of **3a**

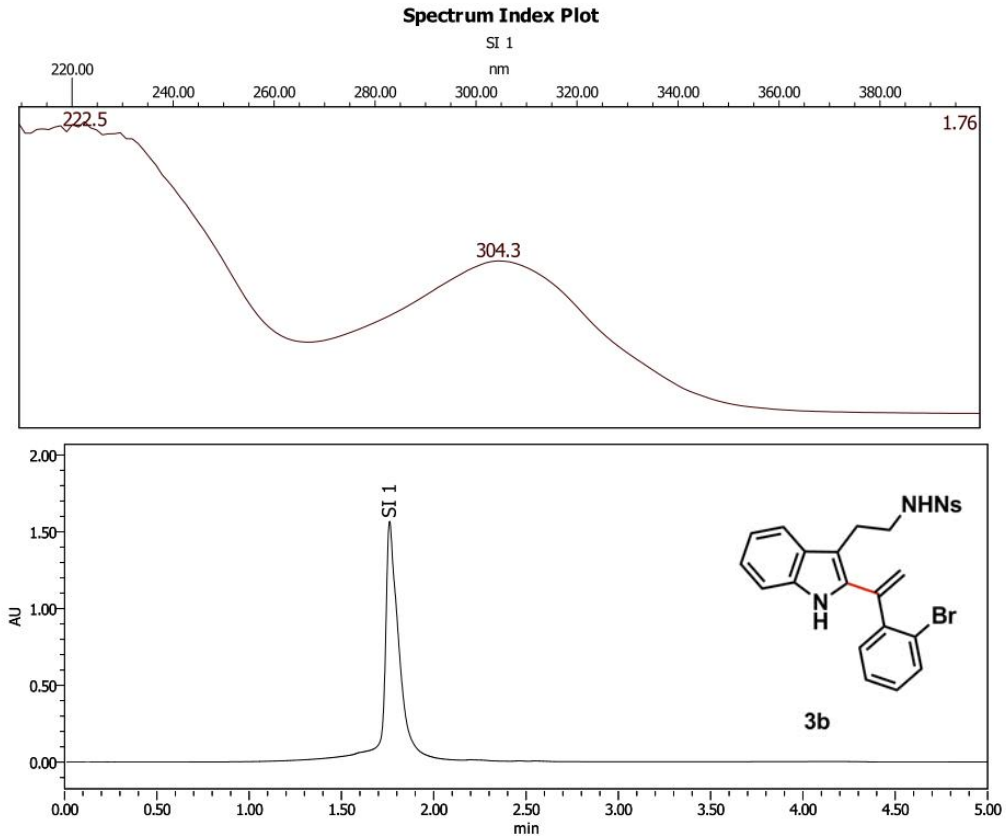


Figure S34. UPLC chromatograph and UV spectra of **3b**

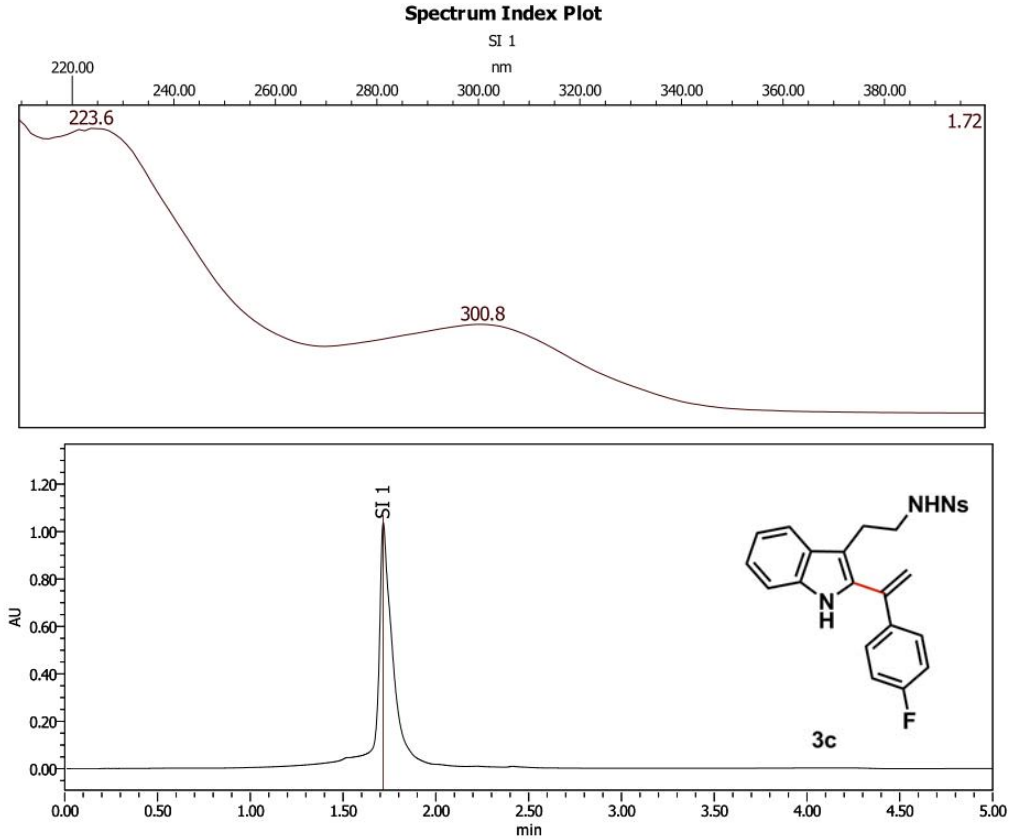


Figure S35. UPLC chromatograph and UV spectra of **3c**

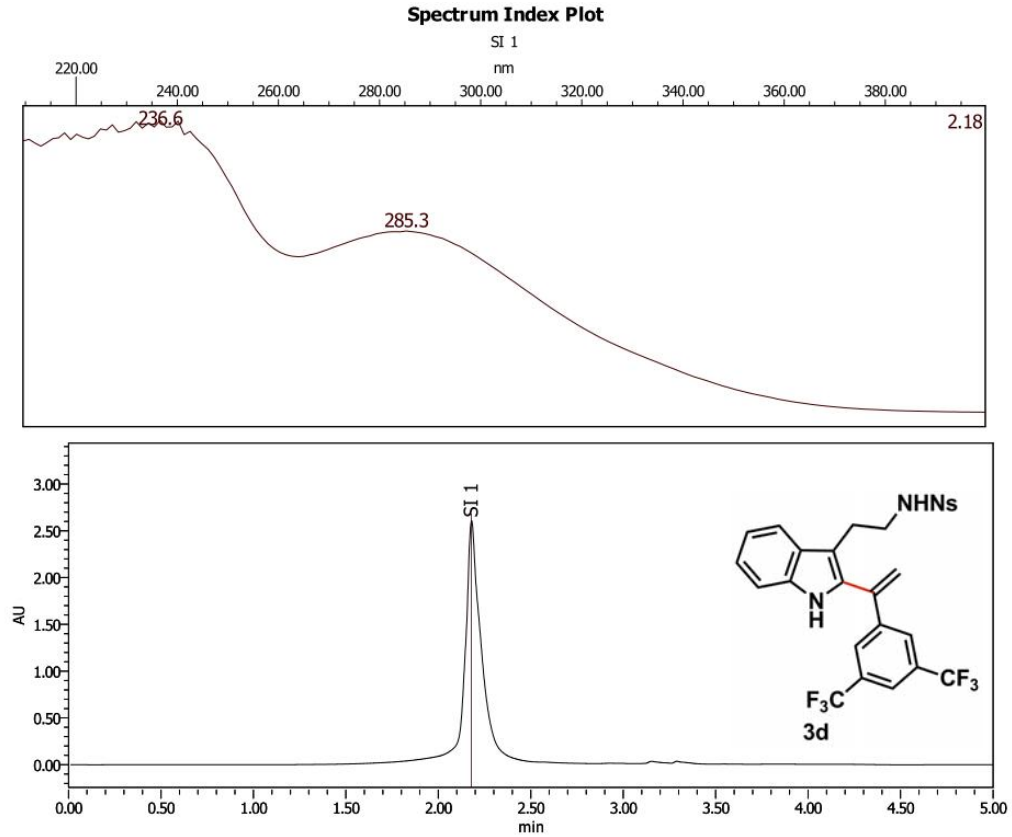


Figure S36. UPLC chromatograph and UV spectra of **3d**

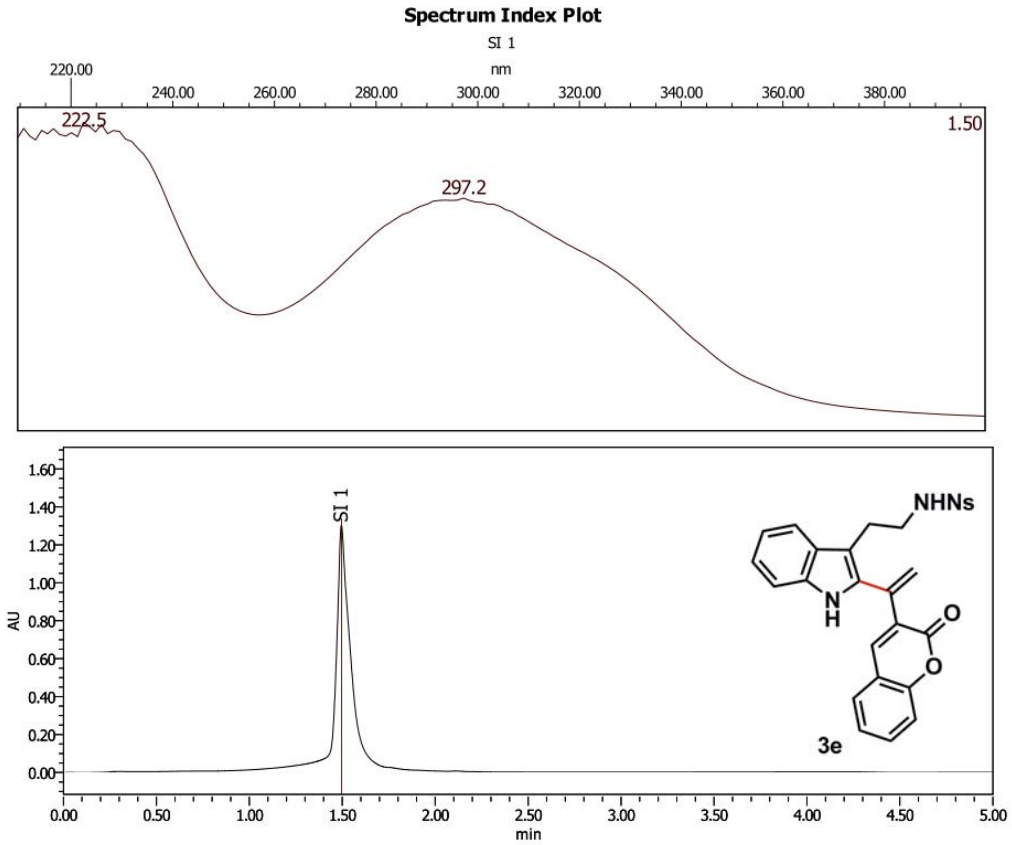


Figure S37. UPLC chromatograph and UV spectra of **3e**

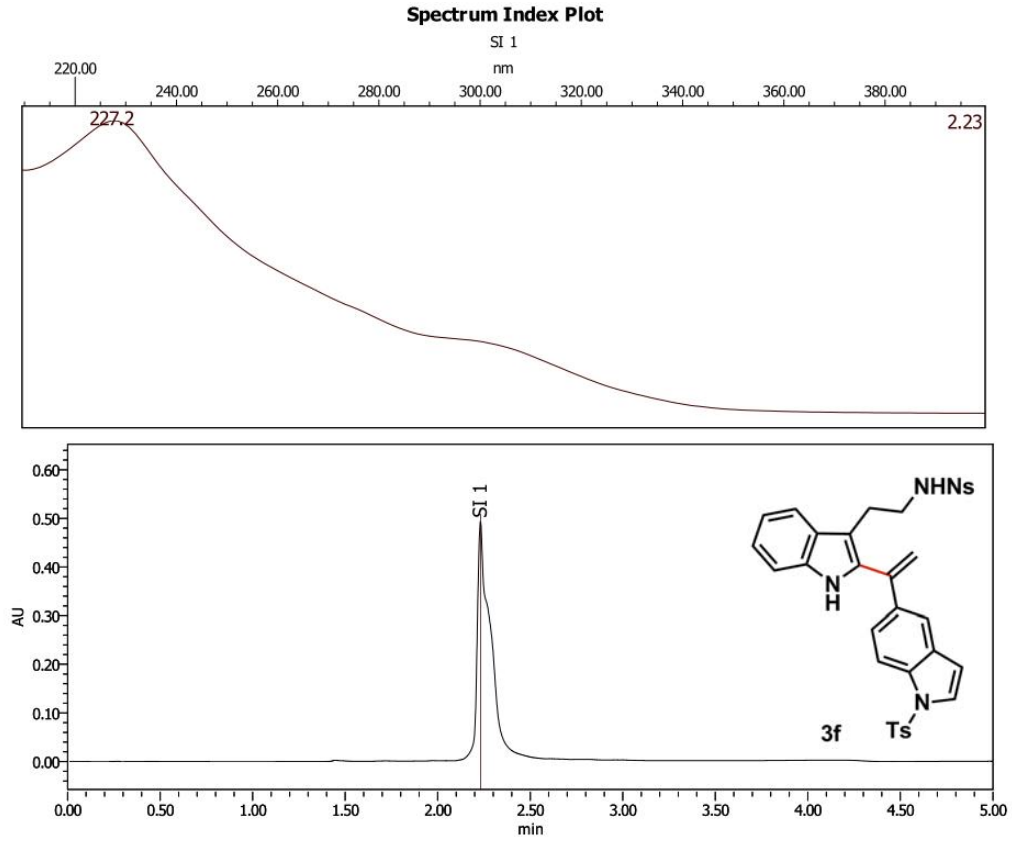


Figure S38. UPLC chromatograph and UV spectra of **3f**

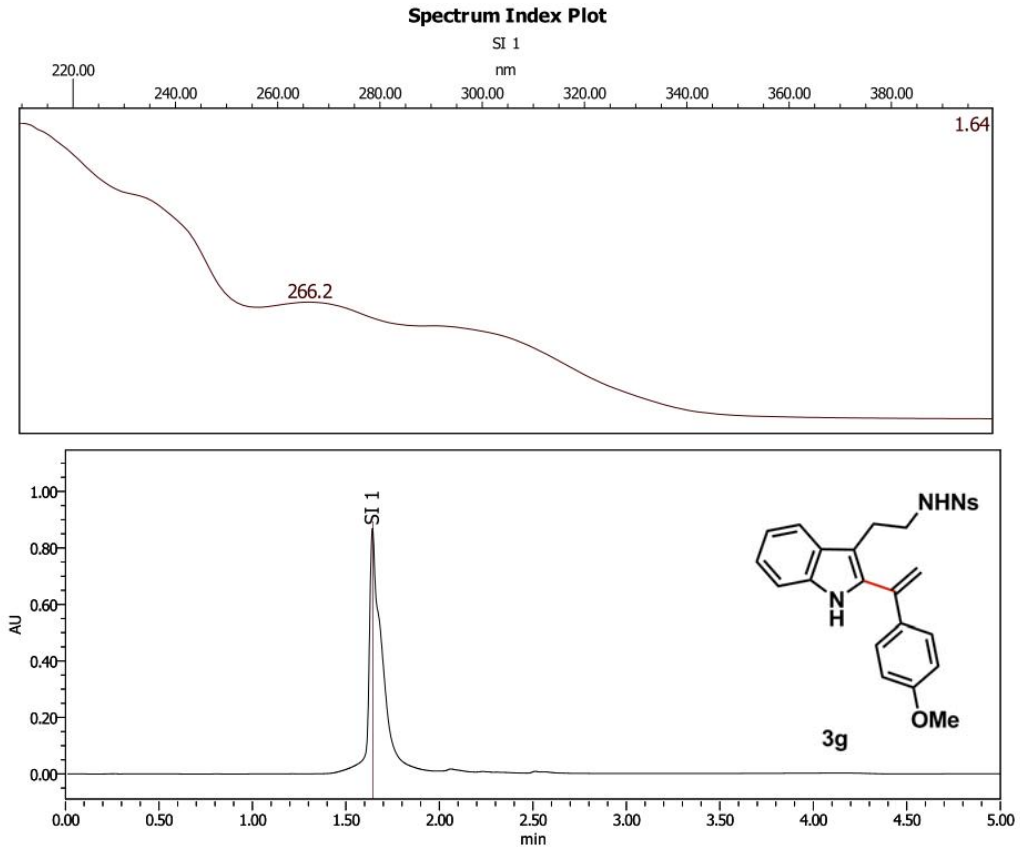


Figure S39. UPLC chromatograph and UV spectra of **3g**

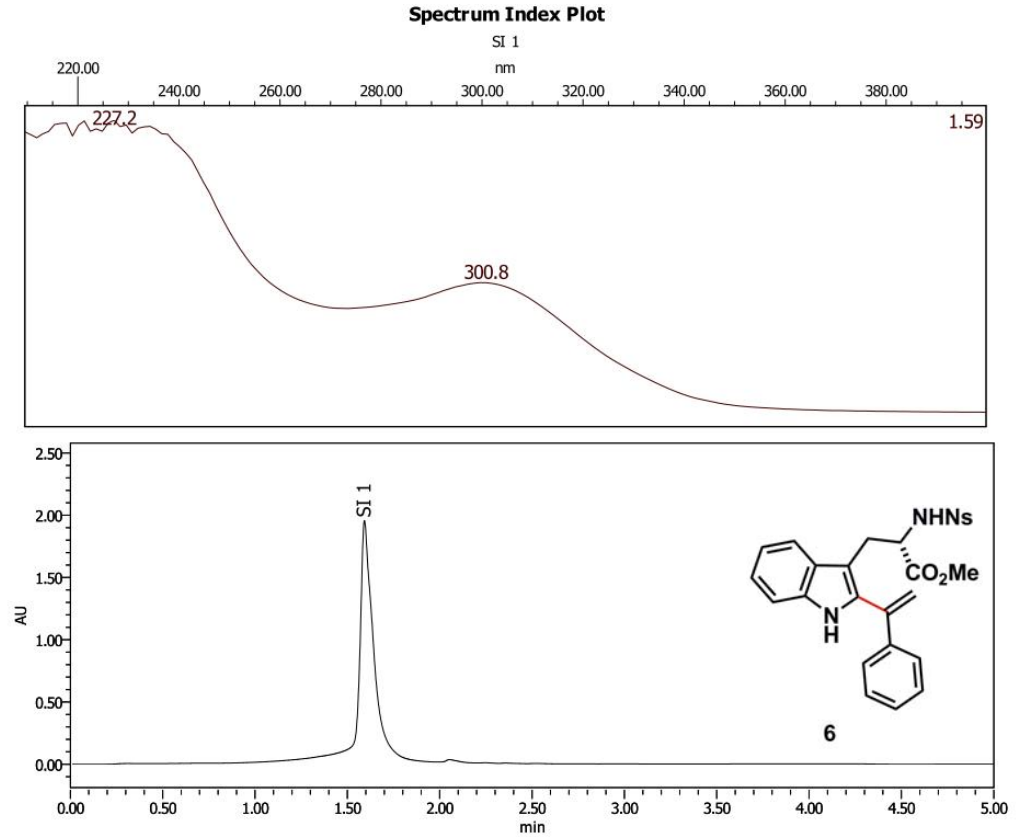


Figure S40. UPLC chromatograph and UV spectra of **6**

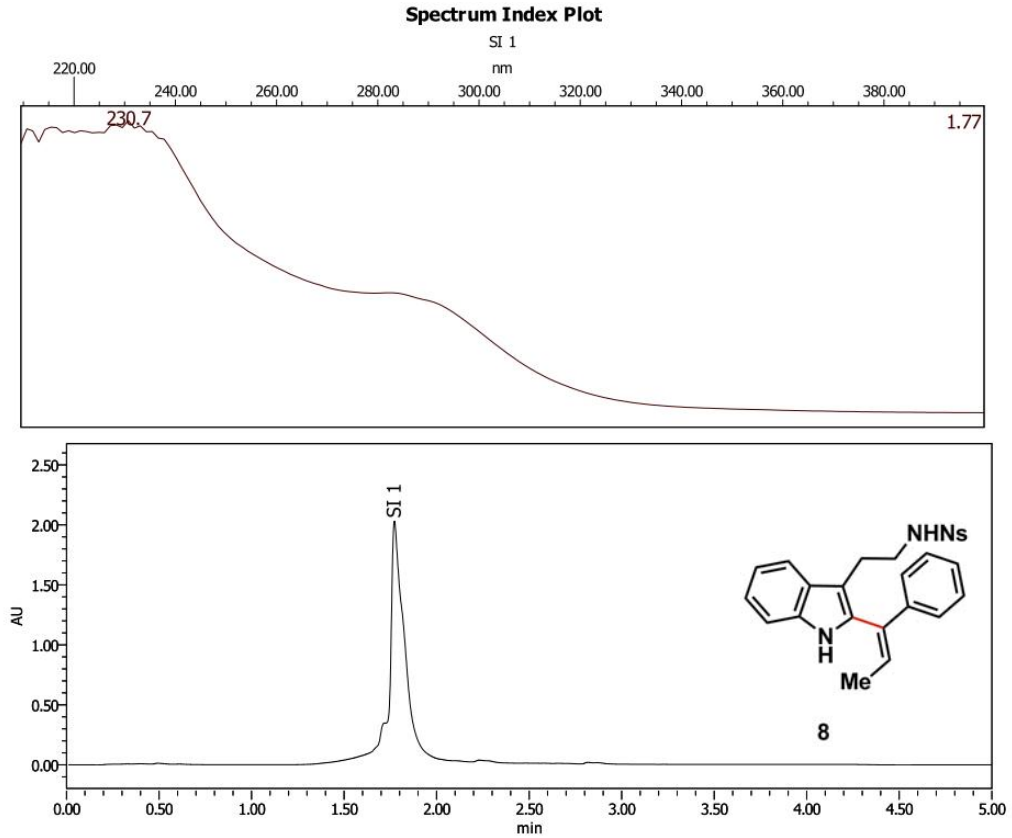


Figure S41. UPLC chromatograph and UV spectra of **8**

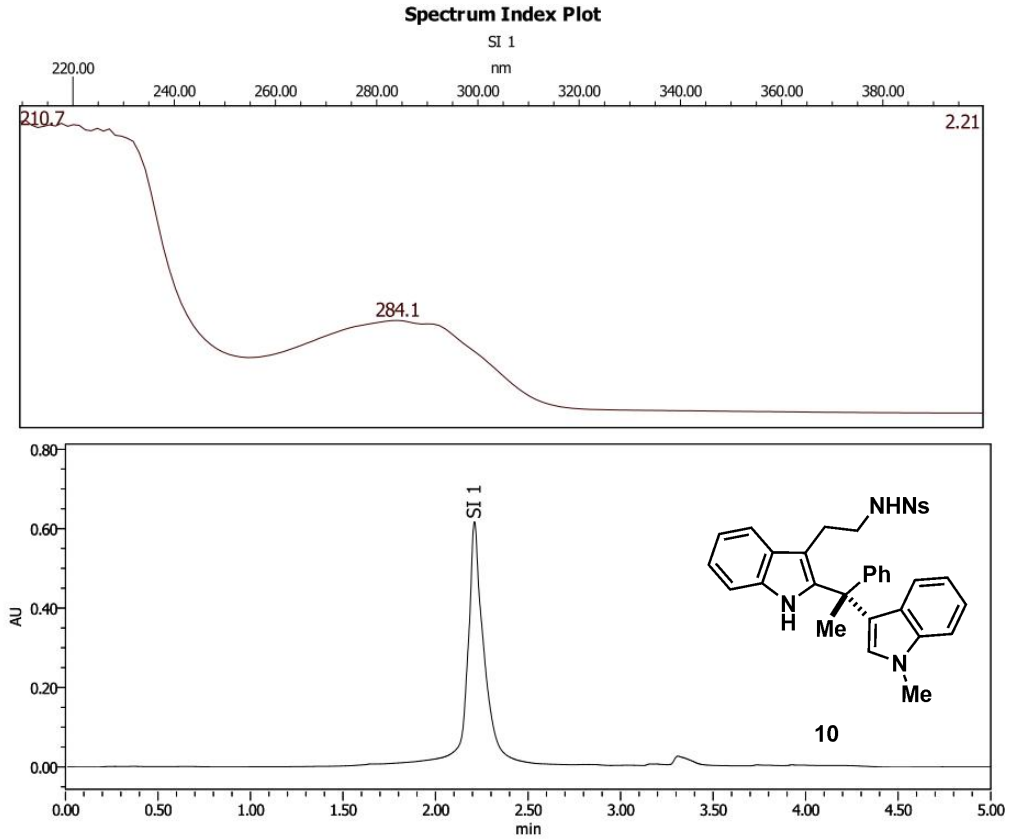


Figure S42. UPLC chromatograph and UV spectra of **10**

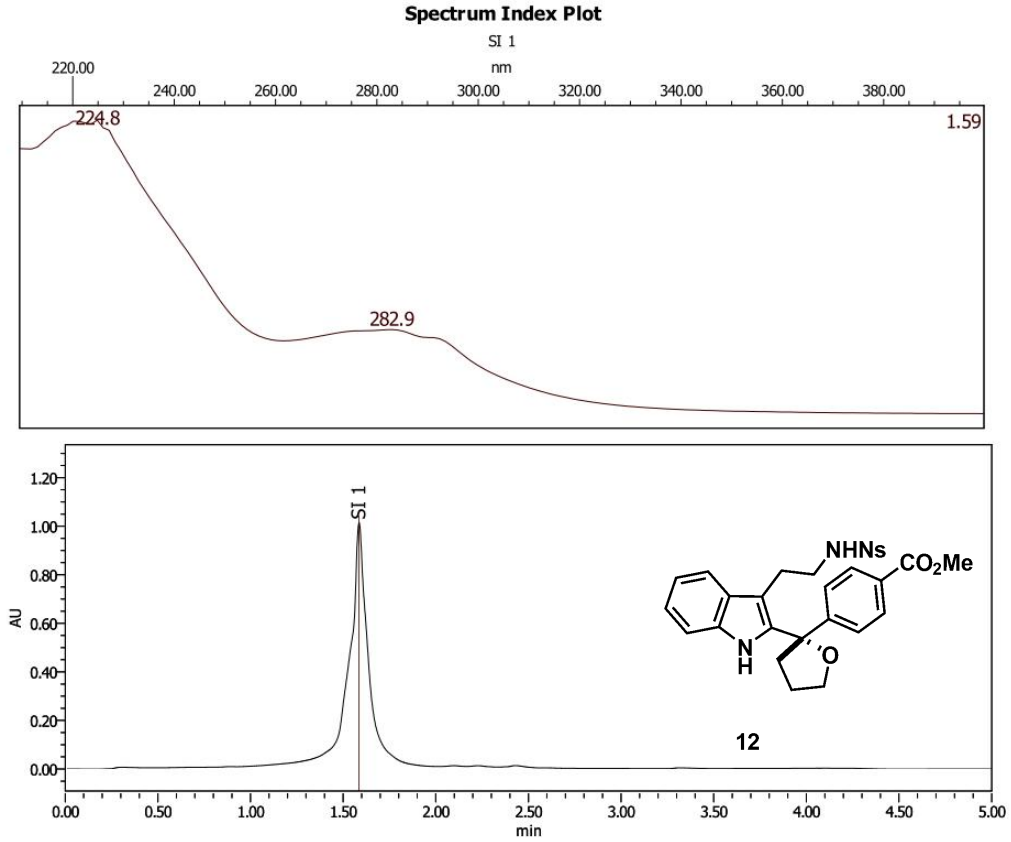


Figure S43. UPLC chromatograph and UV spectra of **12**

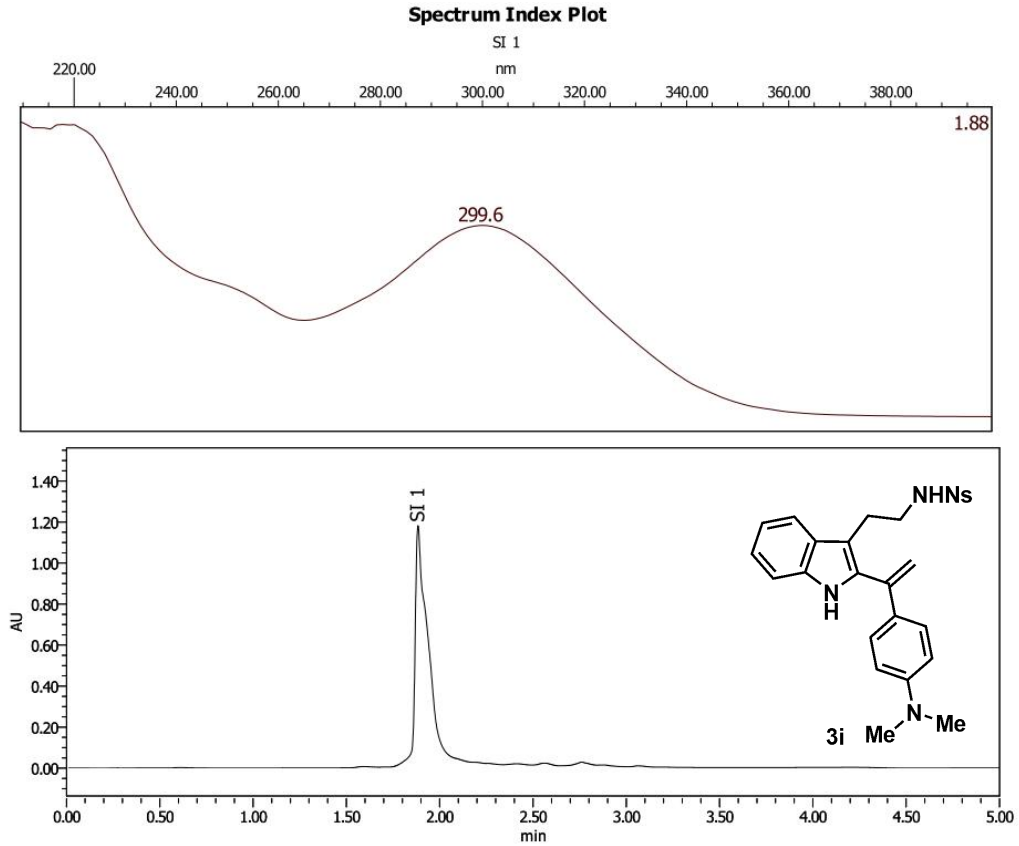


Figure S44. UPLC chromatograph and UV spectra of **3i**

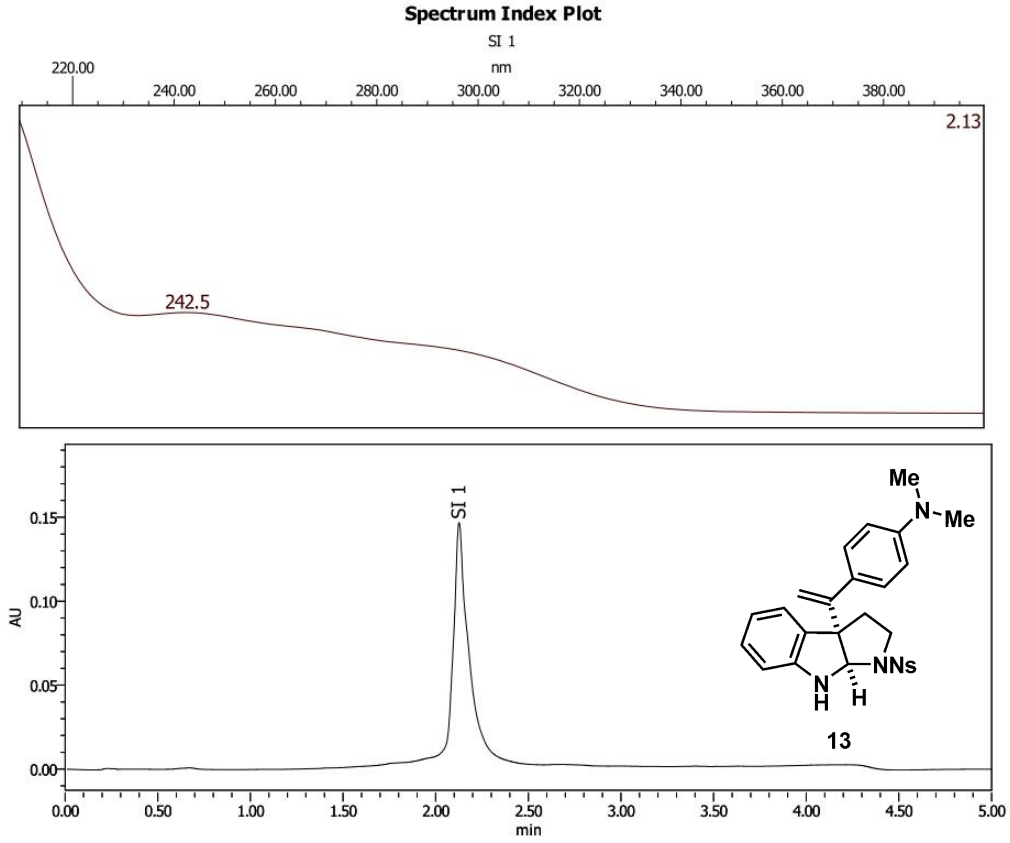


Figure S45. UPLC chromatograph and UV spectra of **13**

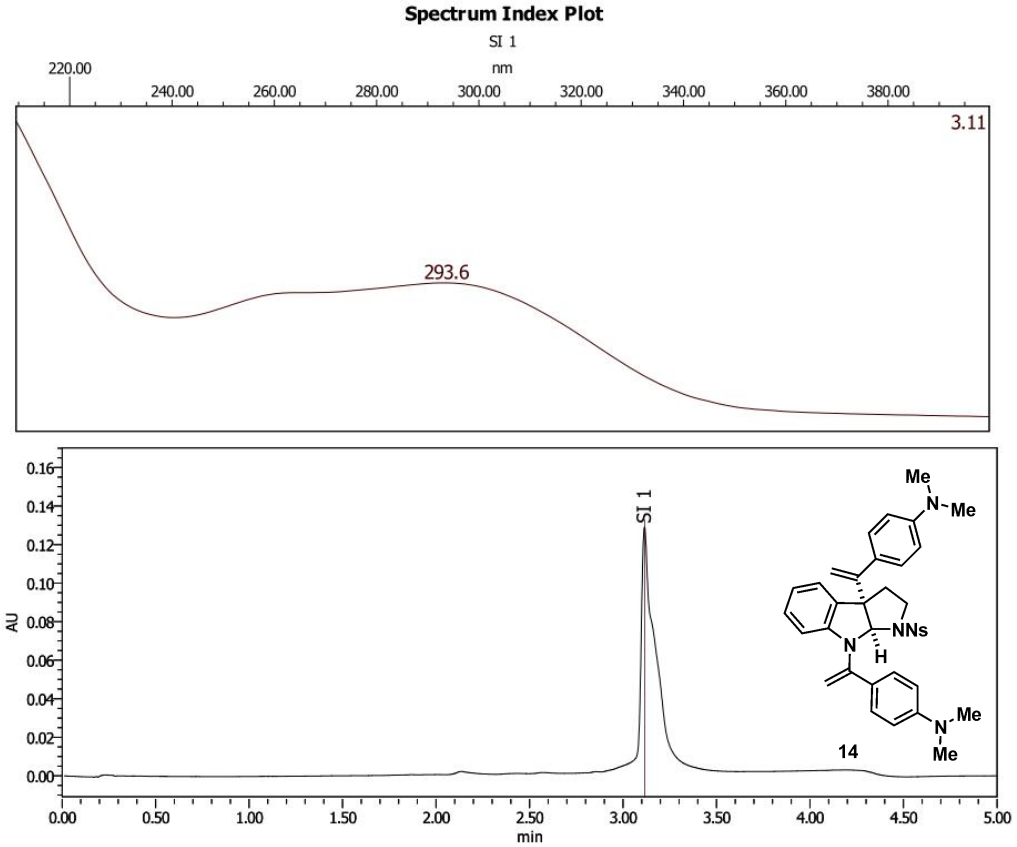


Figure S46. UPLC chromatograph and UV spectra of **14**

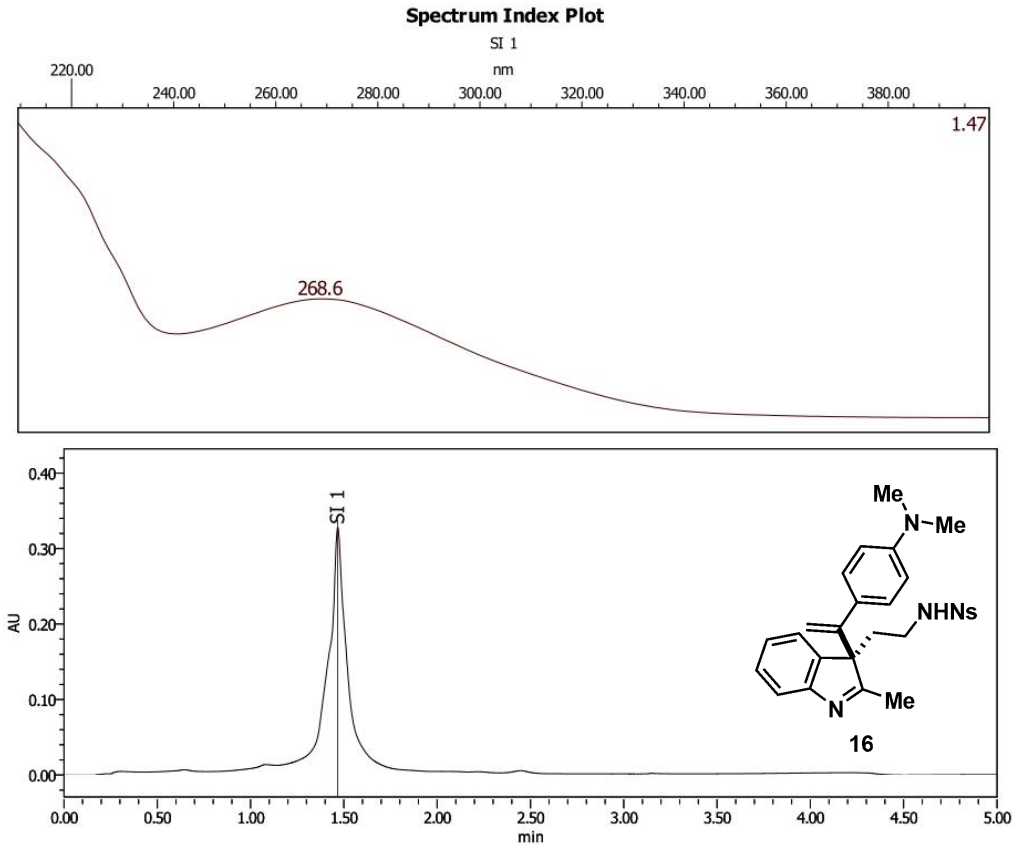


Figure S47. UPLC chromatograph and UV spectra of **16**

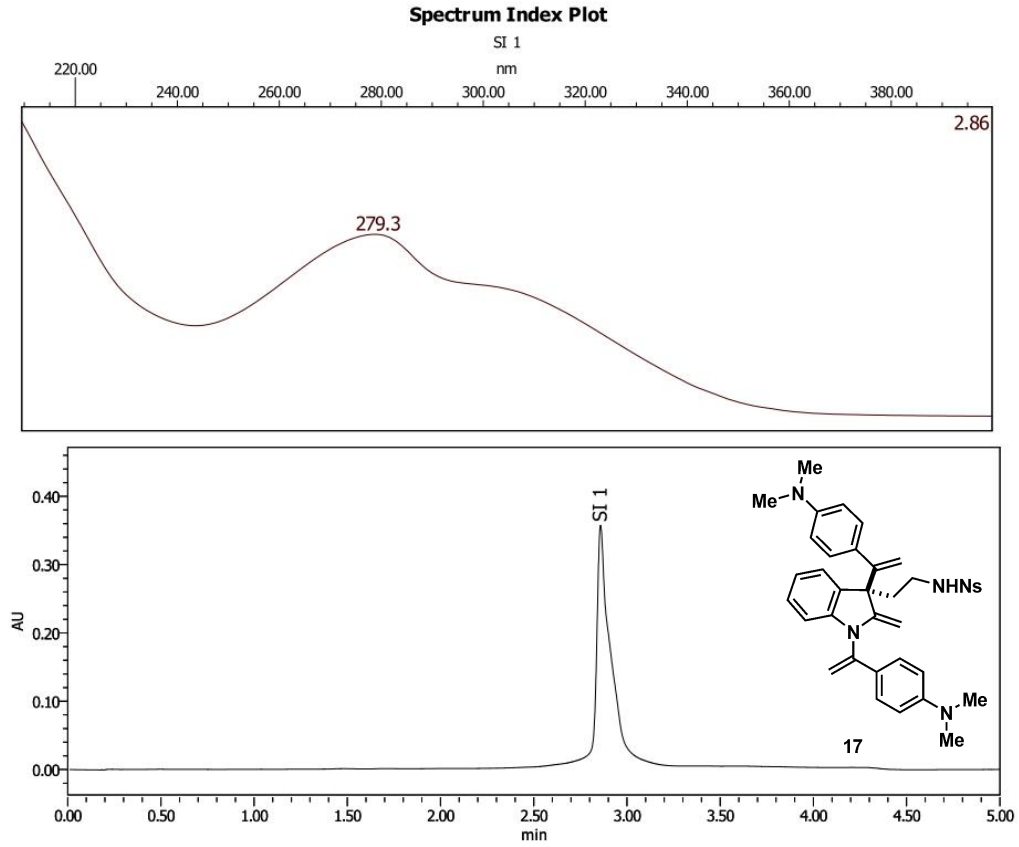


Figure S48. UPLC chromatograph and UV spectra of **17**

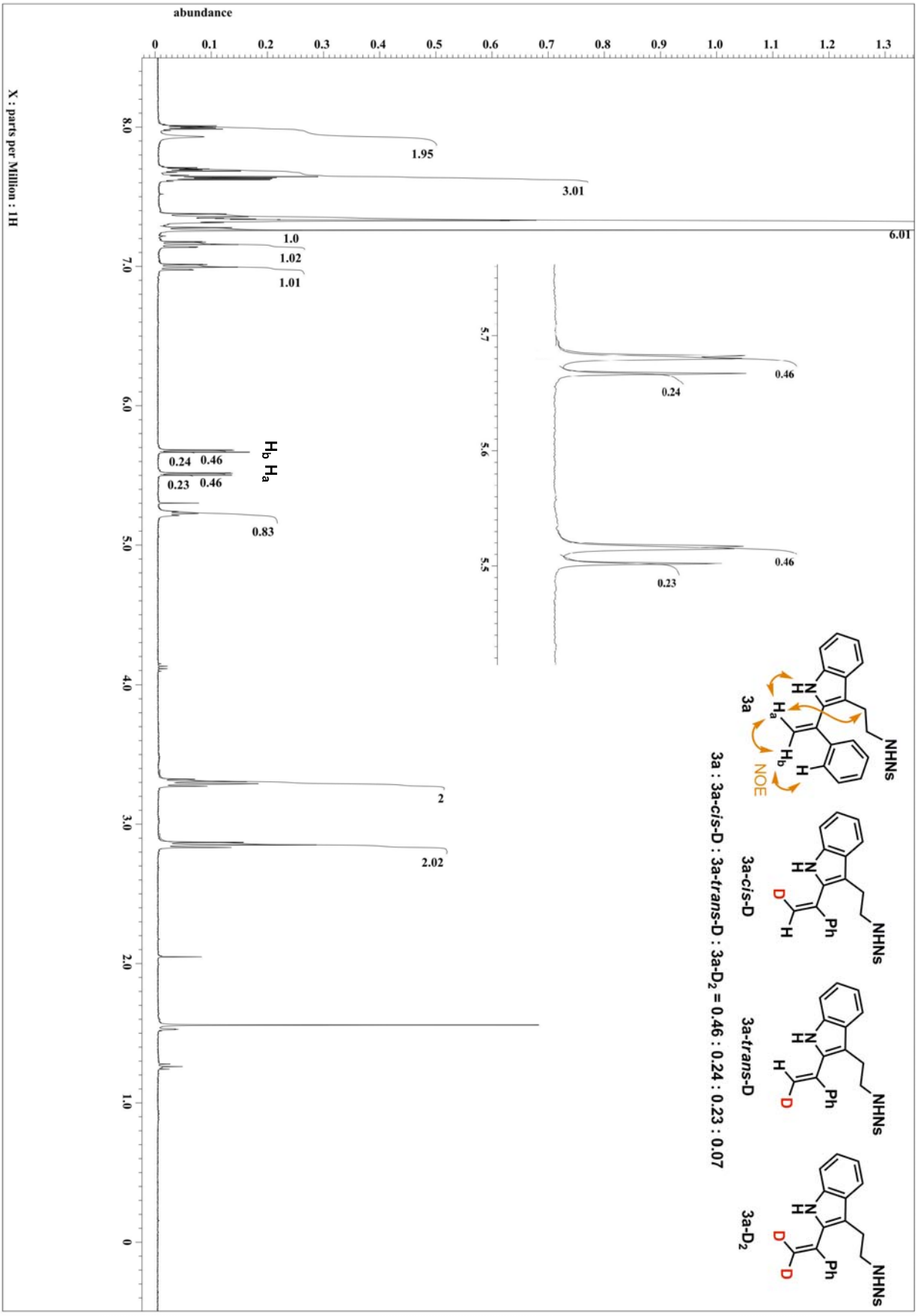
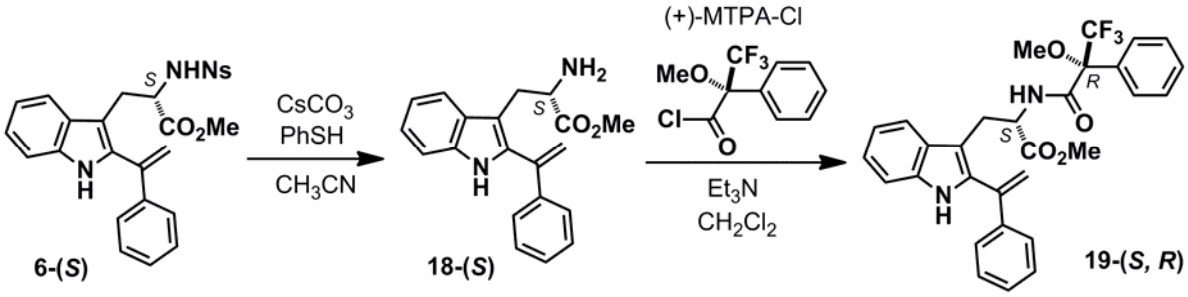


Figure S49. A ^{1}H-NMR spectrum of the deuterated **3a** in $CDCl_3$



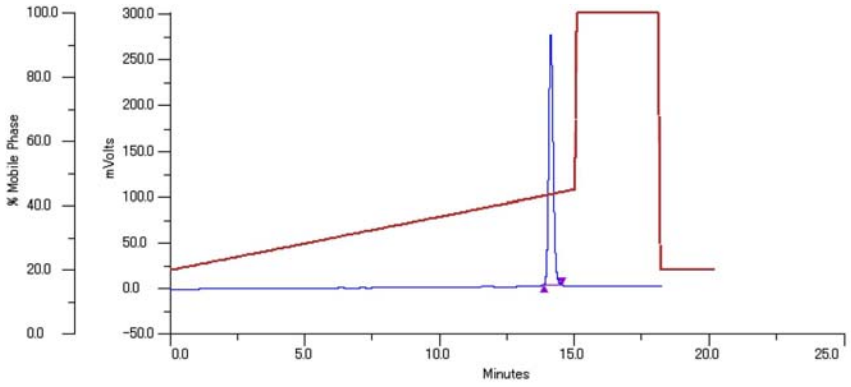
Conversion of 6-(*S*) into MTPA derivative 19-(*S*, *R*) for HPLC analysis

To a solution of vinylated L-tryptophan derivative **(*S*)-6** (20.6 mg, 0.0408 mmol) in acetonitrile (0.5 ml) was added Cs_2CO_3 (20.0 mg, 0.0612 mmol) and benzenethiol (1.6 μl, 0.0448 mmol) at 0 °C. After stirring at room temperature for 3 h, the mixture was added H_2O and extracted with dichloromethane, dried over Na_2SO_4, and concentrated. The crude mixture was then dissolved in dichloromethane (1.0 ml) and treated with triethylamine (8.6 μl, 0.0617 mmol) and (+)-α-Methoxy-α-(trifluoromethyl)phenylacetyl chloride (8.4 μl, 0.0449 mmol) at 0 °C. After stirred at 0 °C for 75 min, the mixture was added saturated $NaHCO_3$ (aq.) and extracted with EtOAc. The organic extracts were washed with saturated $NaHCO_3$ (aq.) and brine, dried over Na_2SO_4, and concentrated. The residue was purified by silica-gel column chromatography to afford **19-(*S*, *R*)** 15.4 mg (0.0355 mmol, 87%).

According to the same procedure, 1:1 diastereomeric mixture of **19-(*S*, *R*)** and **19-(*R*, *R*)** was synthesized using D/L-tryptophan as starting material.

As shown in Figure S50, the extent of preservation of original chirality of L-tryptophane was estimated as >98% by the HPLC (Inertsil® SIL-100A 10×250 mm, Hexane-AcOEt 80:20 to 55:45, gradient time 15 min, flow rate 3 mL/min)

19-(*S*, *R*) derived from L-tryptophan



Diastereomeric mixture of **19-(*R*, *R*) : 19-(*S*, *R*) = 1 : 1** derived from D/L-tryptophan

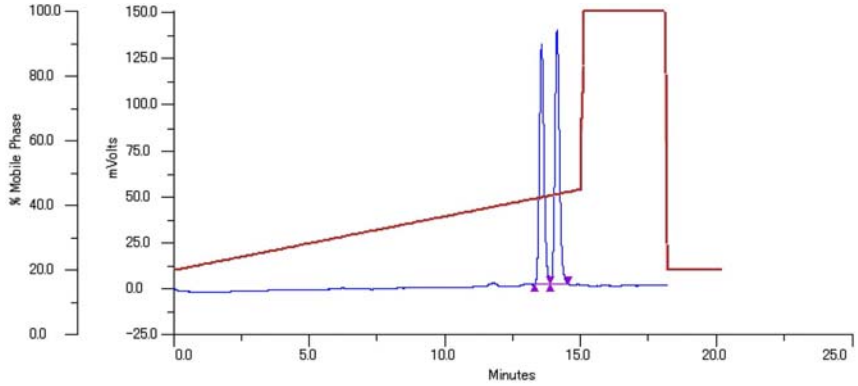


Figure S50. HPLC chromatograms for the (+)-MTPA derivatives of vinylated tryptophan

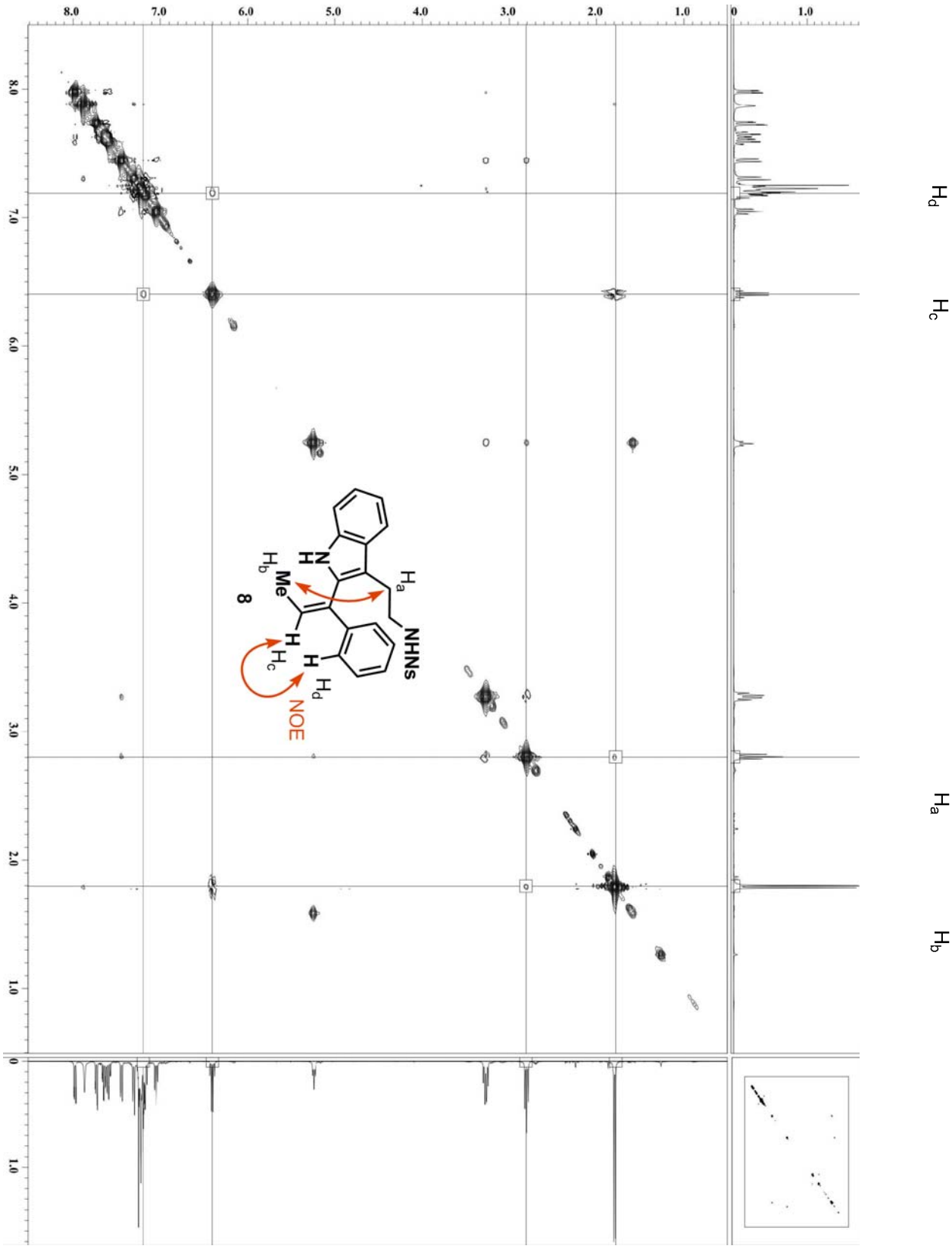


Figure S51. A NOESY spectrum of **8** in $CDCl_3$