

Synthesis of novel piperazine-based bis(thiazole)(1,3,4-thiadiazole) hybrids as anti-cancer agents through caspase-dependent apoptosis

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Spectral data

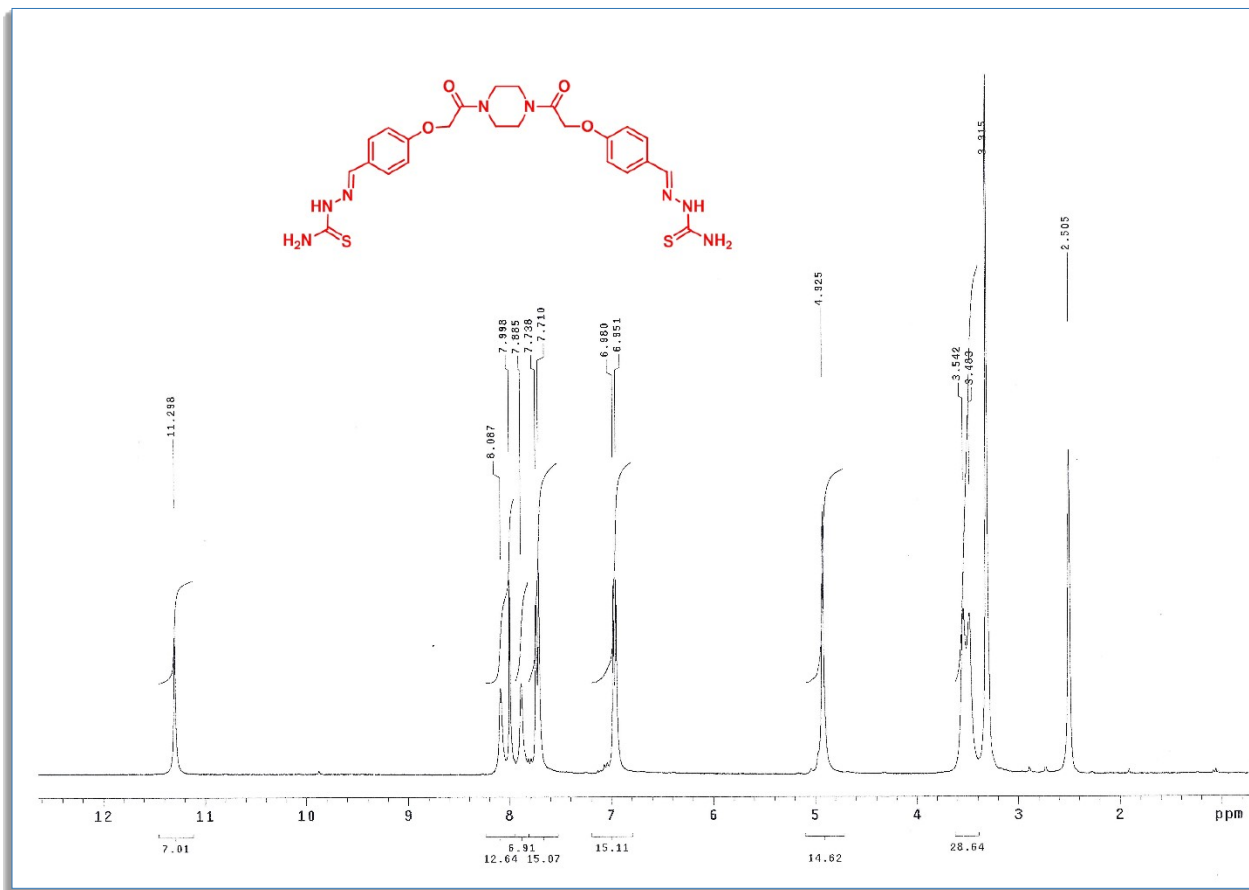


Fig. S1. ¹H NMR spectrum of 7a

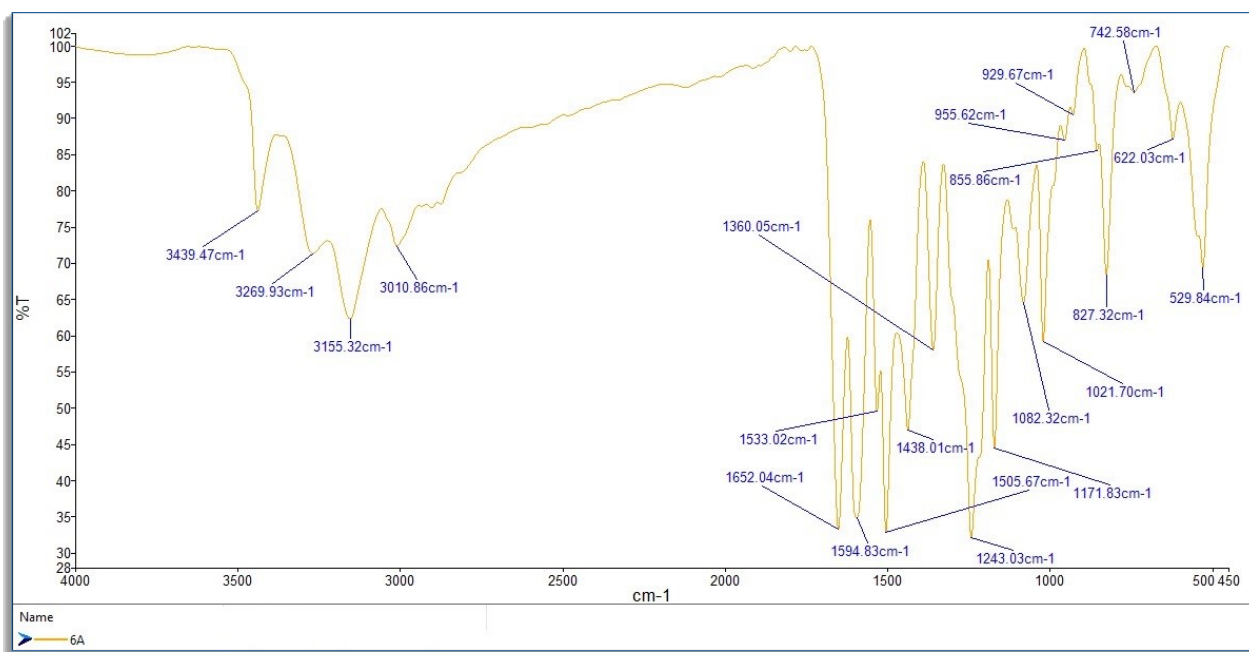


Fig. S2. IR spectrum of 7a

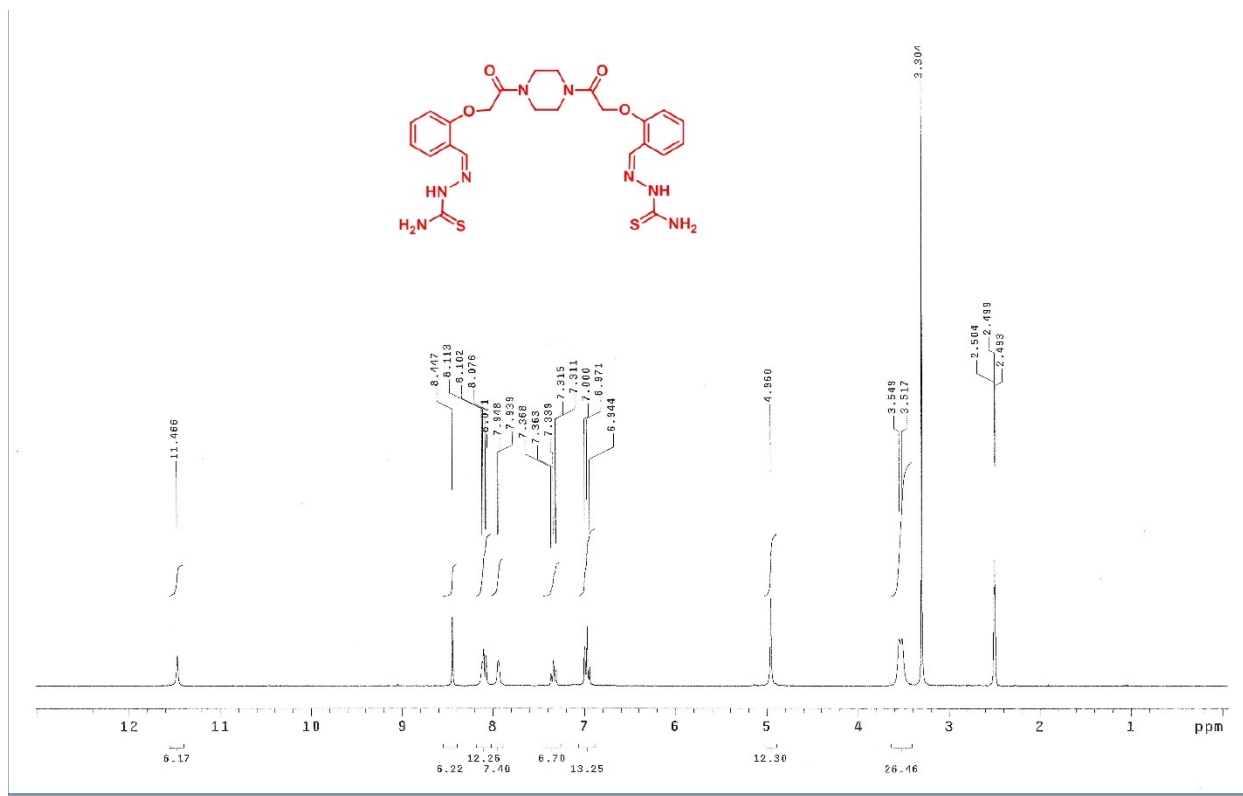


Fig. S3. ¹H NMR spectrum of 7b

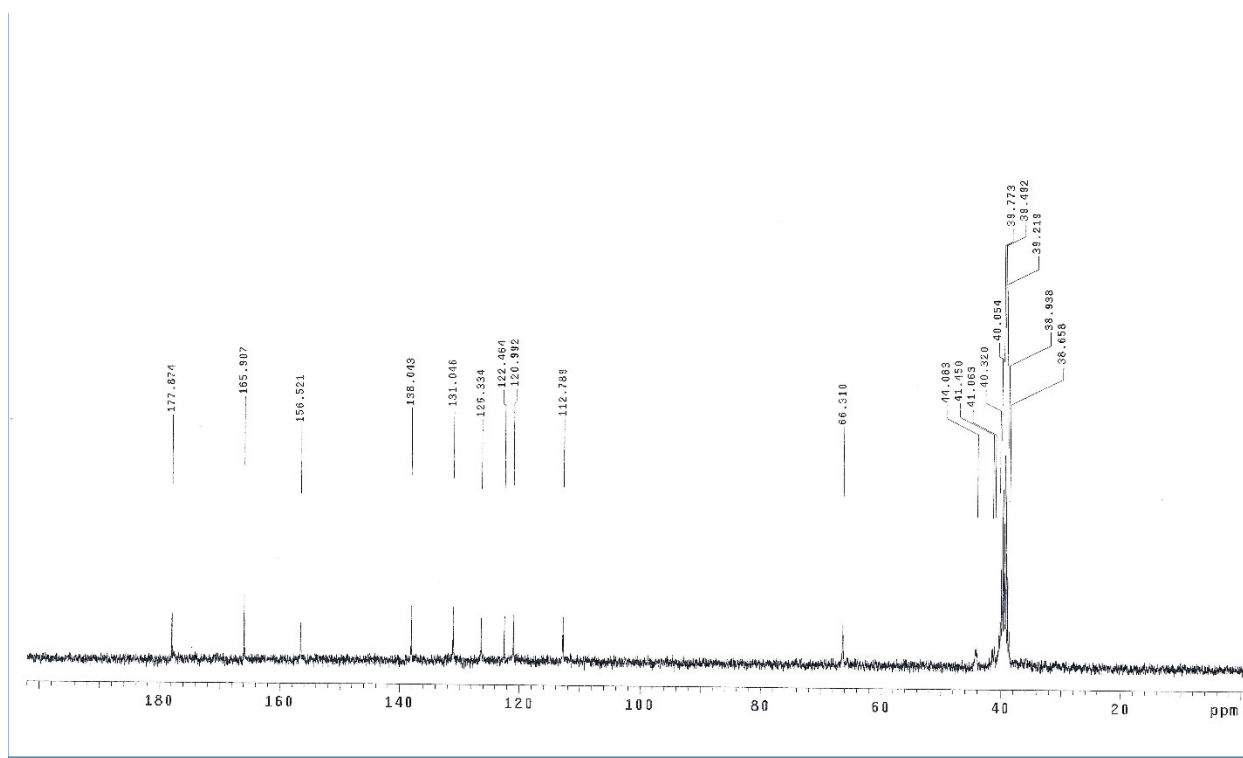


Fig. S4. ¹³C NMR spectrum of 7b

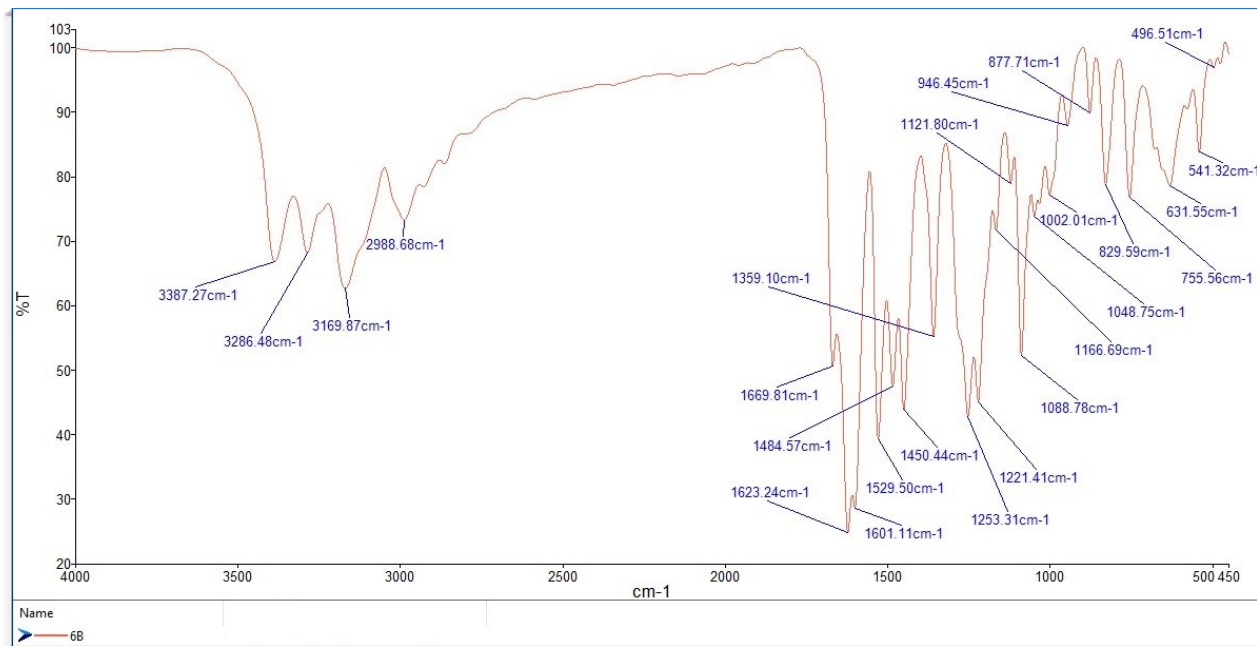


Fig. S5. IR spectrum of 7b

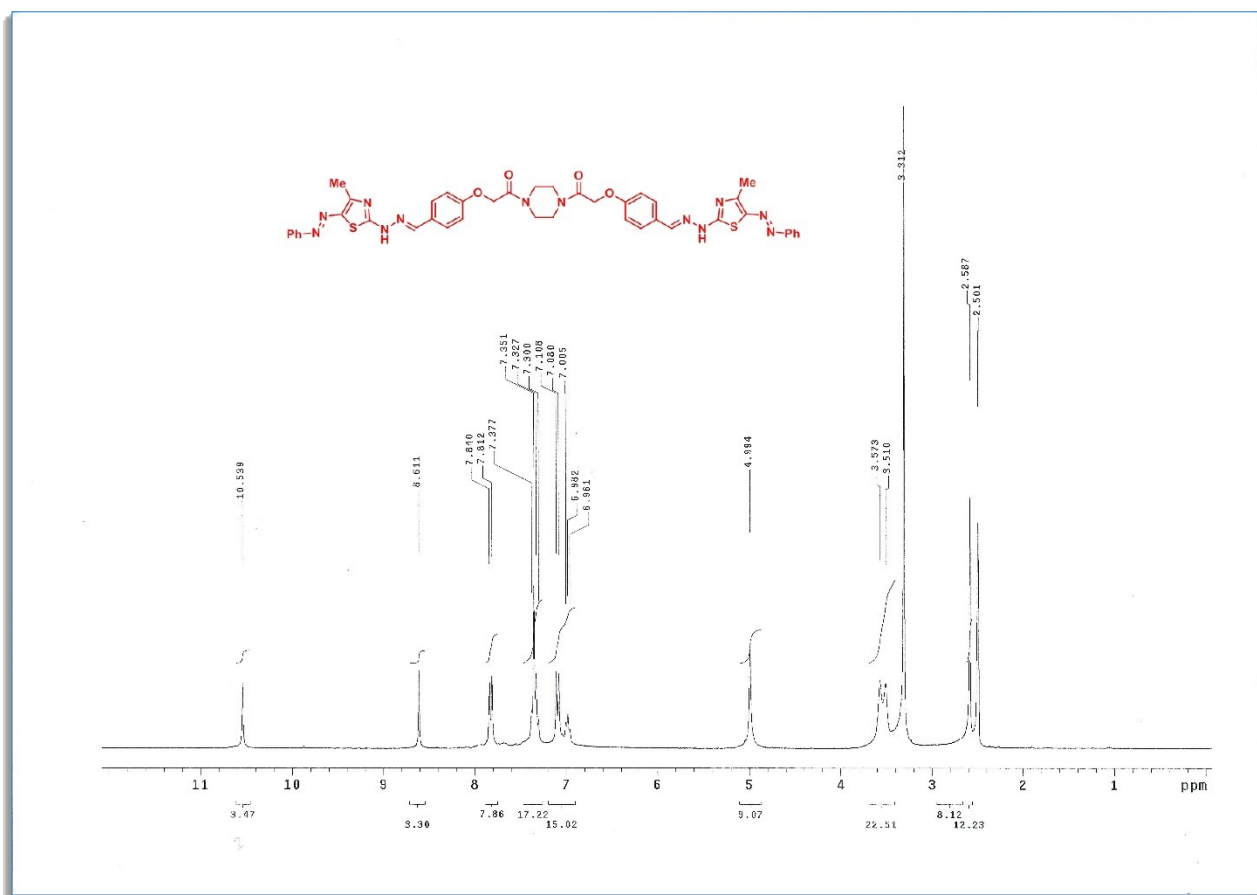


Fig. S6. ¹H NMR spectrum of 9a

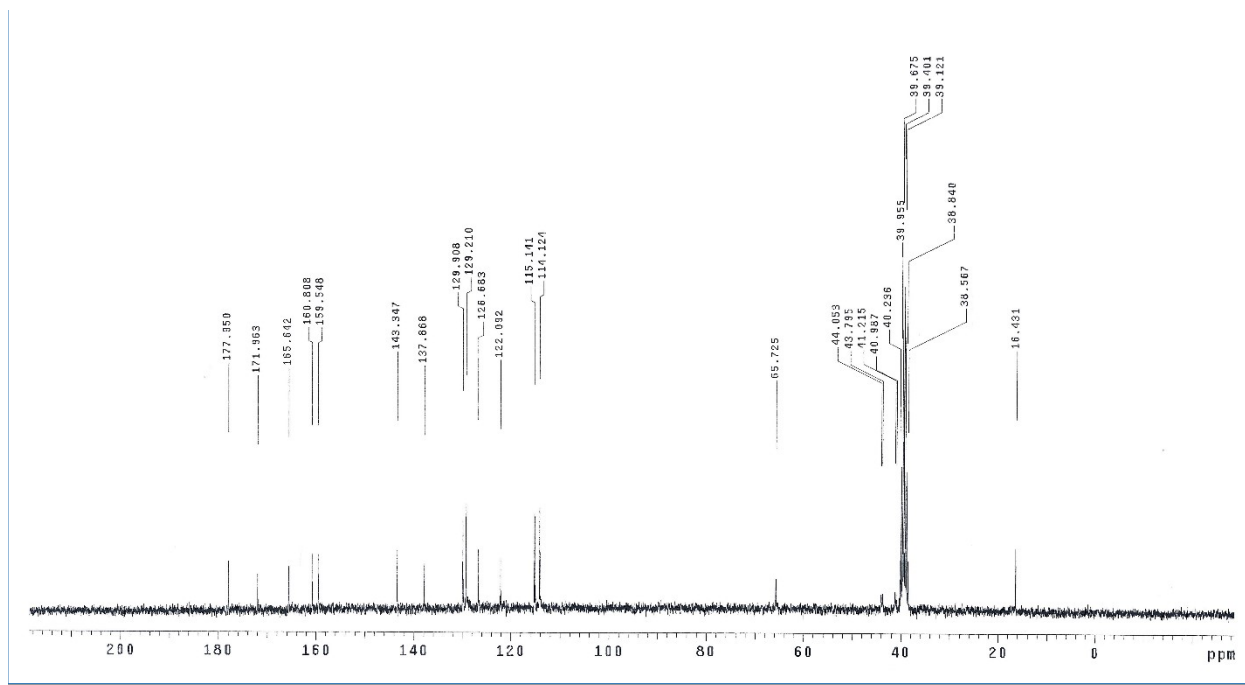


Fig. S7. ^{13}C NMR spectrum of **9a**

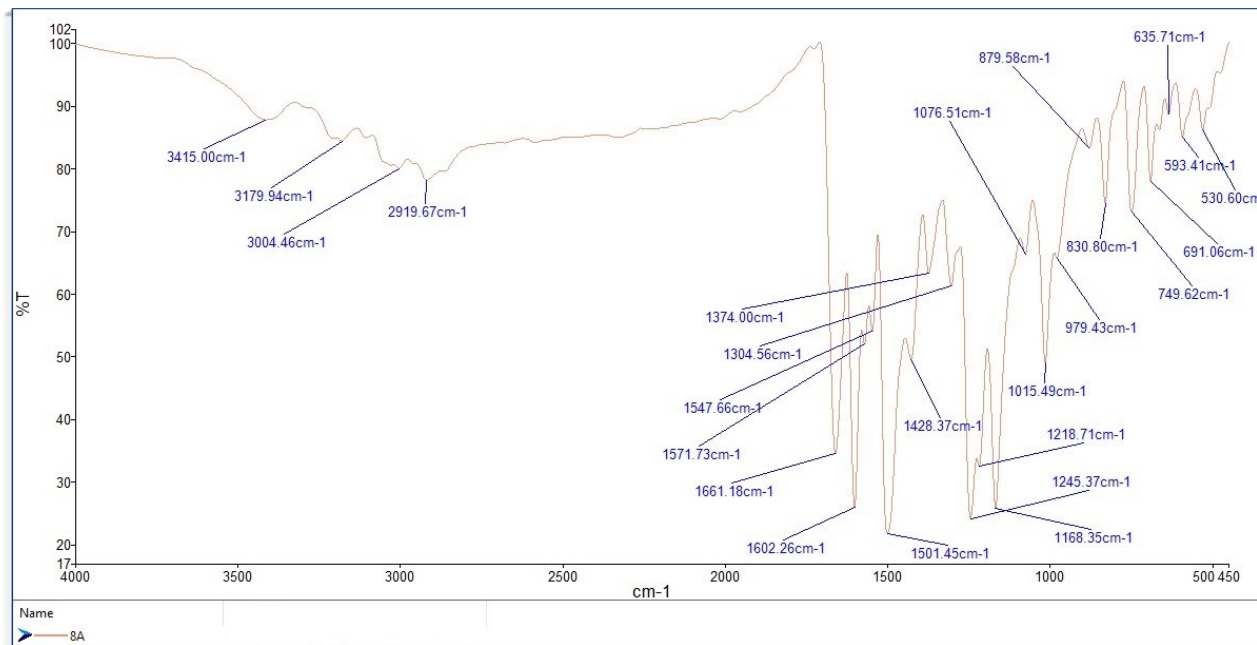


Fig. S8. IR spectrum of **9a**

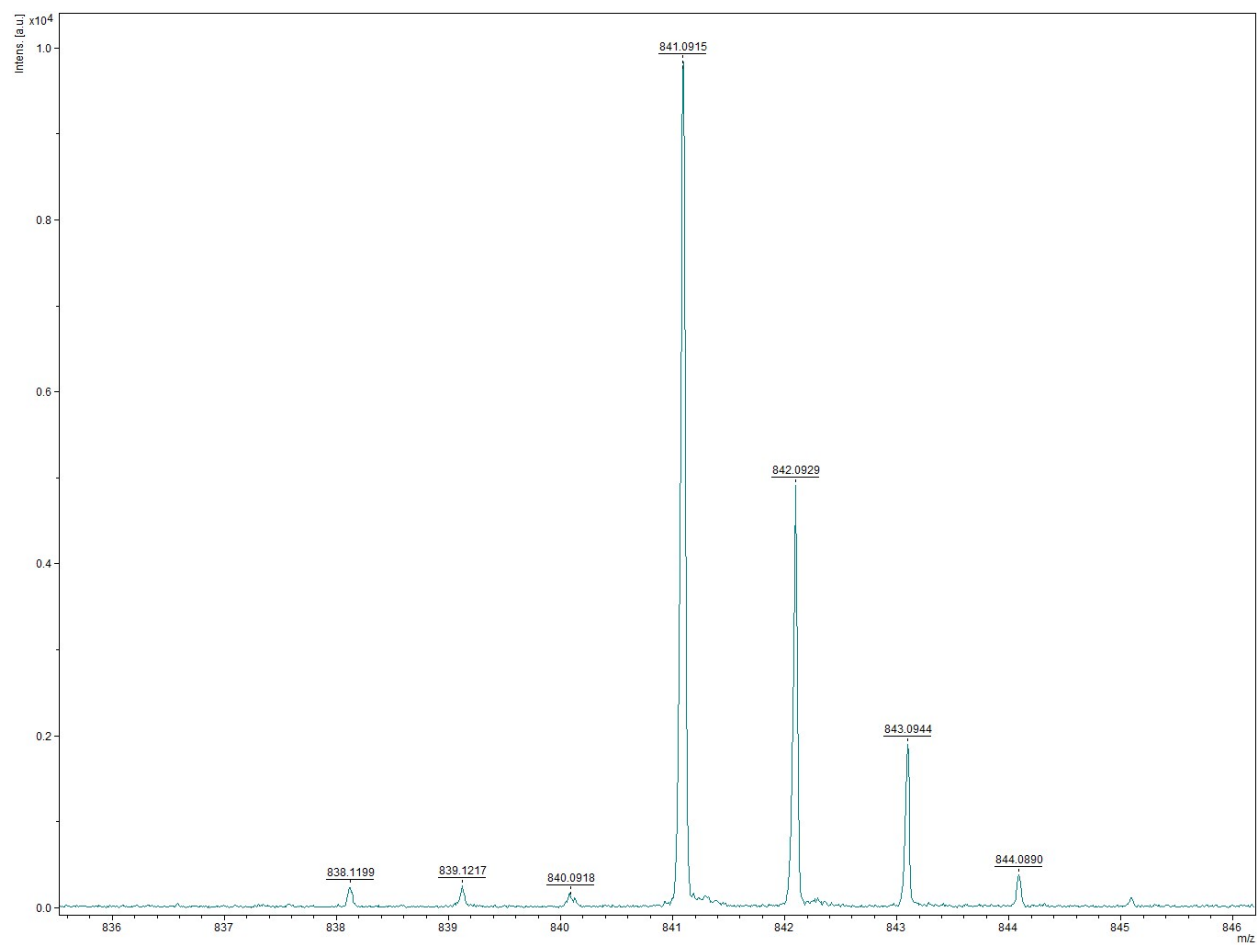


Fig. S9. Mass spectrum of **9a**

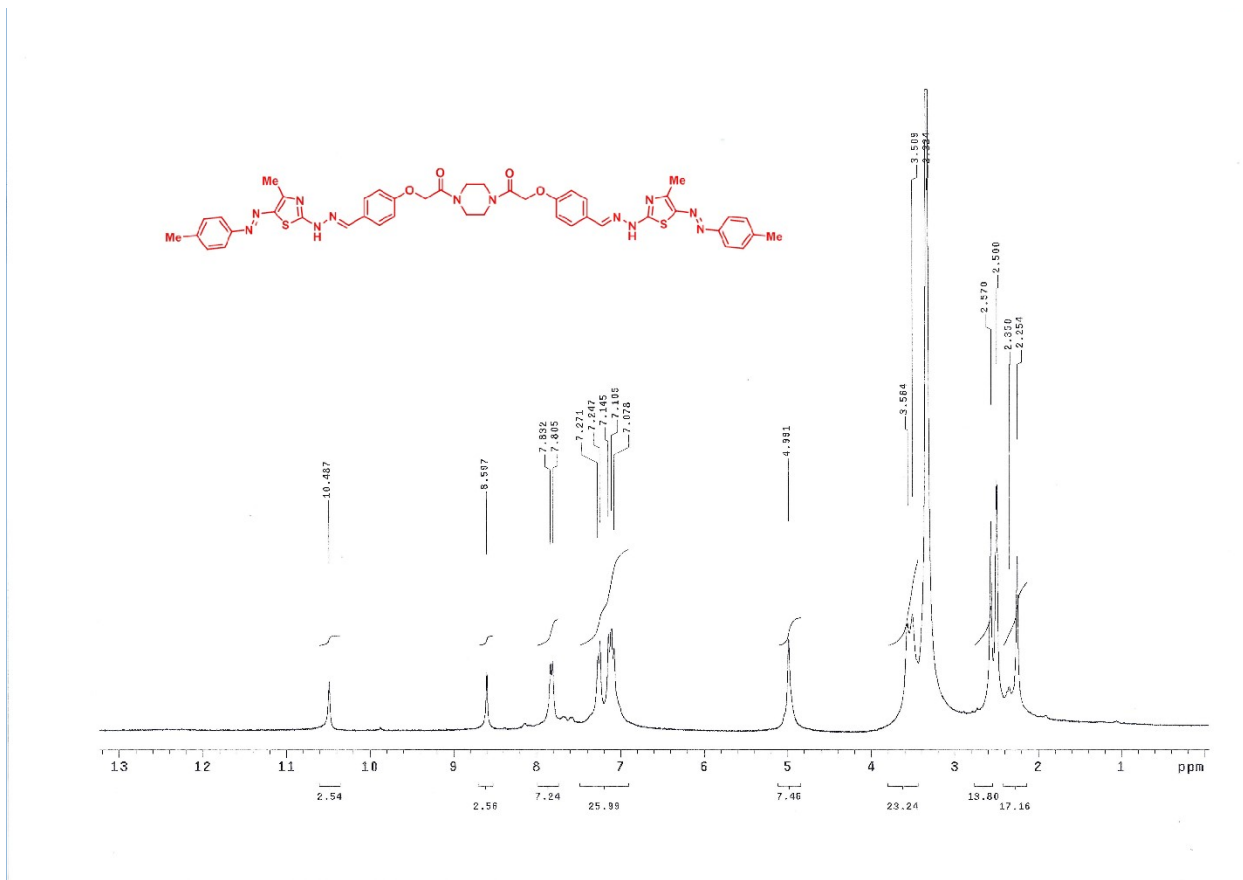


Fig. S10. ¹H NMR spectrum of **9b**

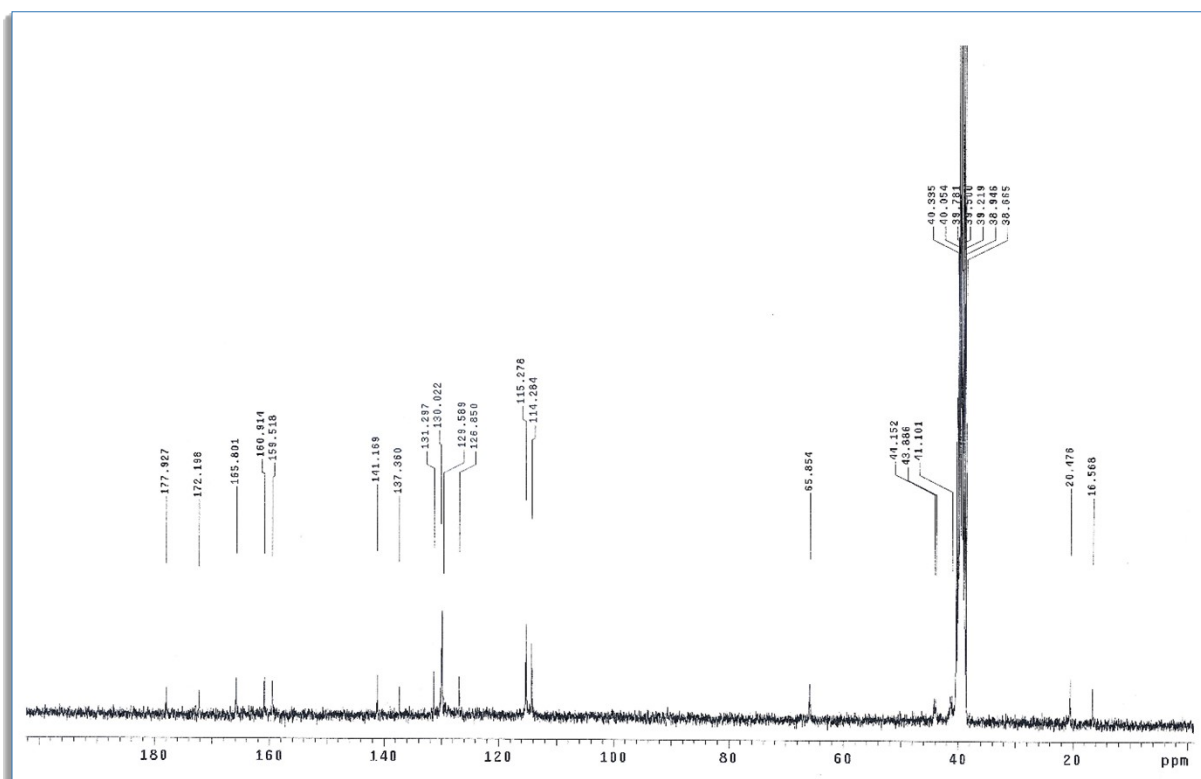


Fig. S11. ¹³C NMR spectrum of **9b**

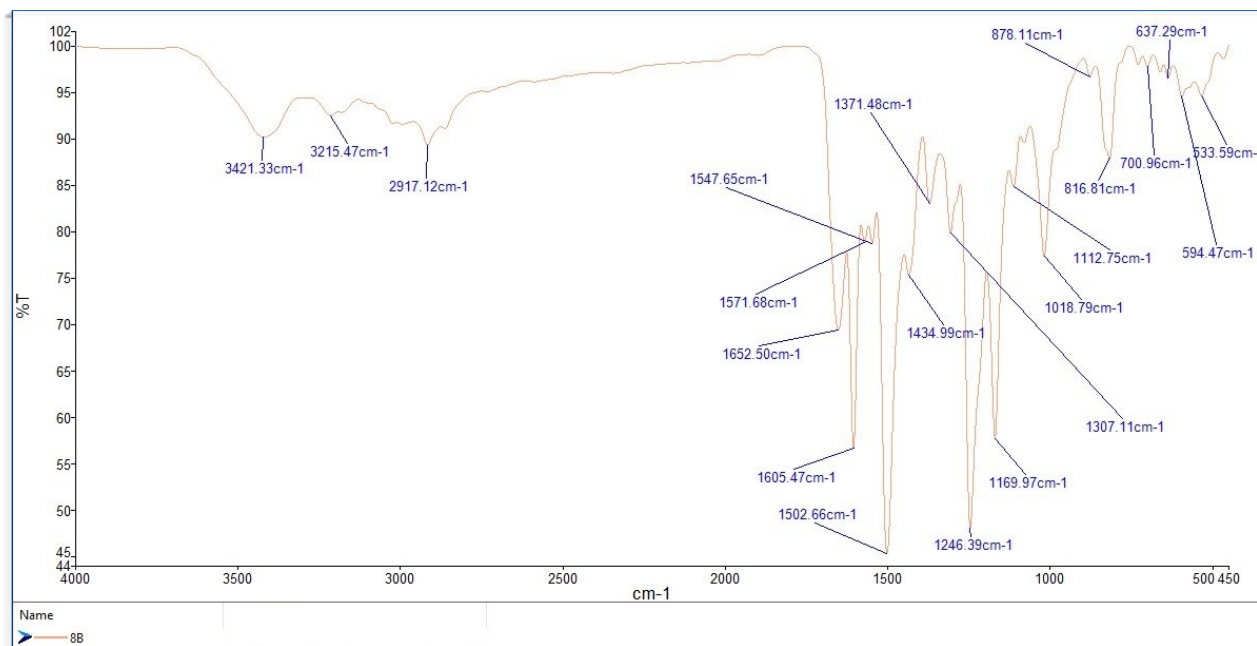


Fig. S12. IR spectrum of **9b**

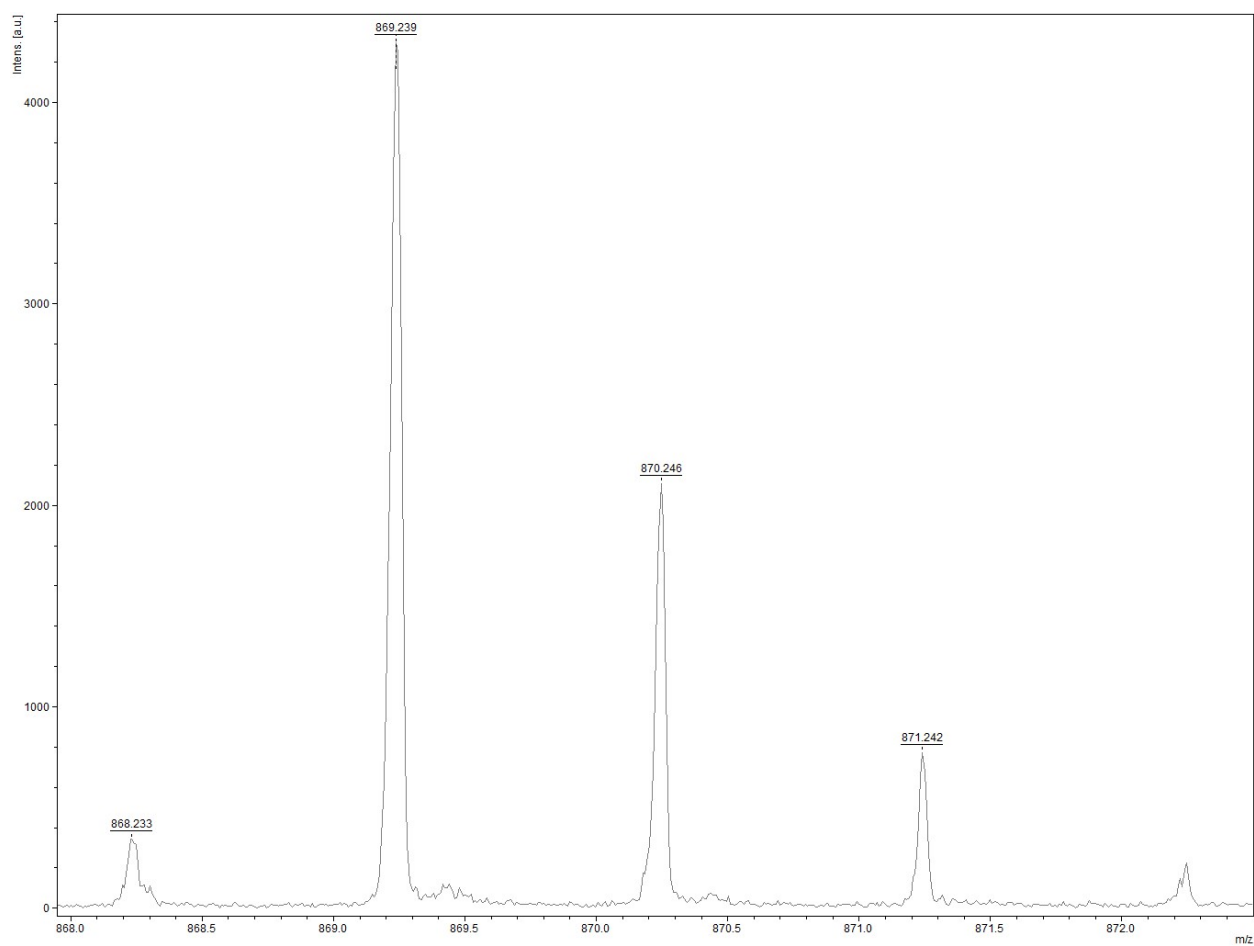


Fig. S13. Mass spectrum of **9b**

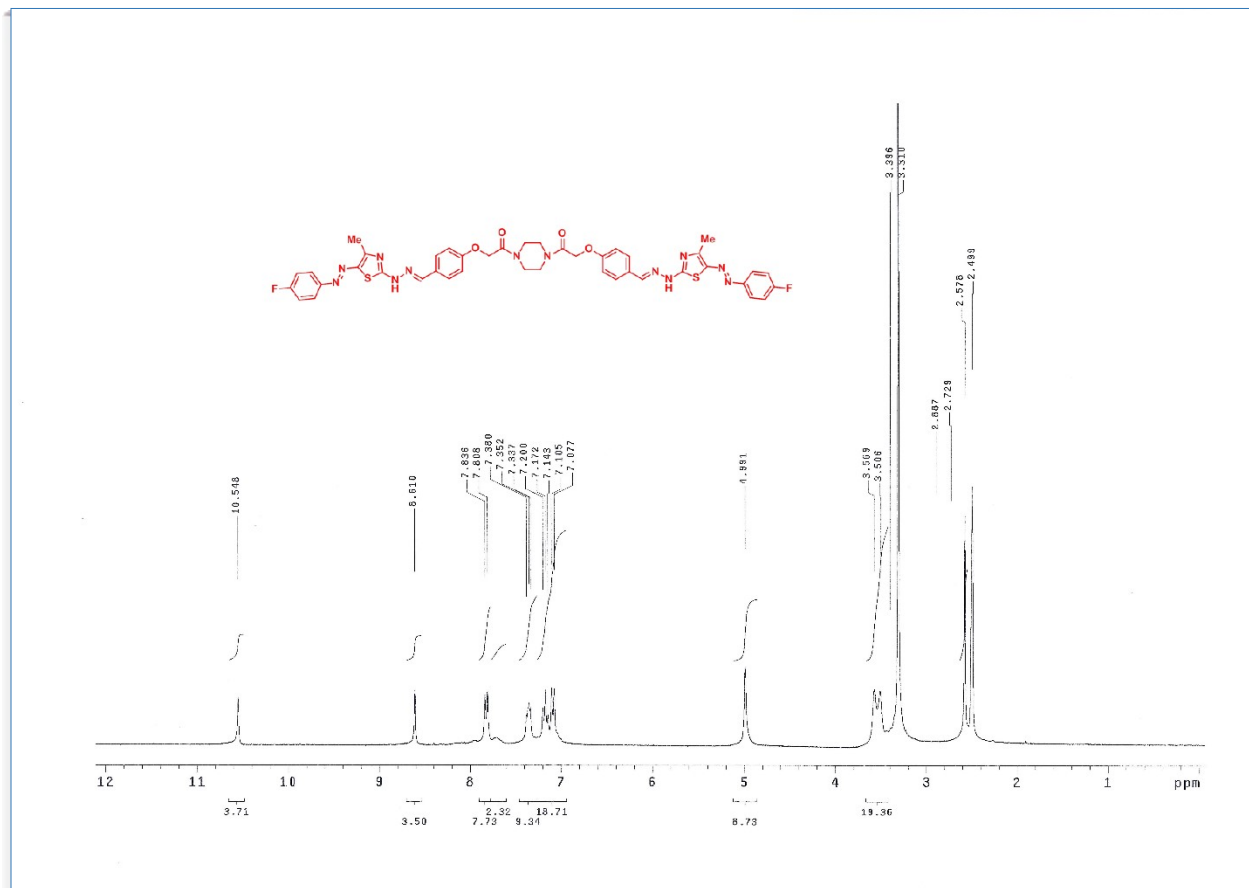


Fig. S14. $^1\text{H NMR}$ spectrum of **9c**

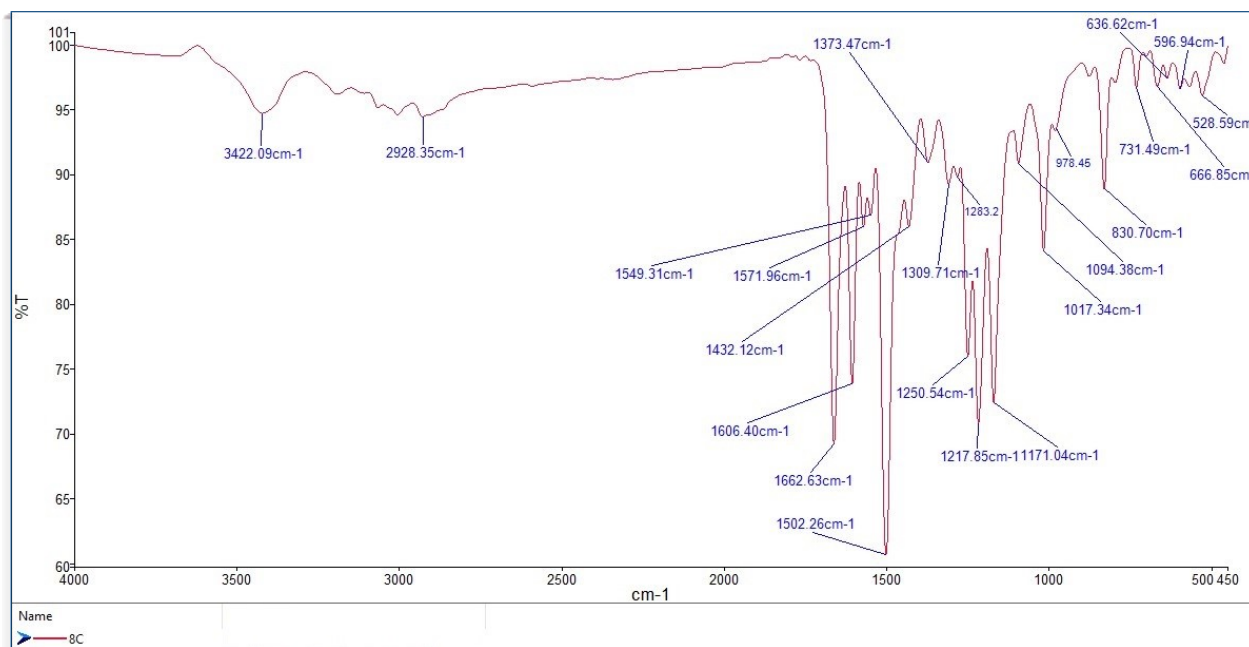


Fig. S15. IR spectrum of **9c**

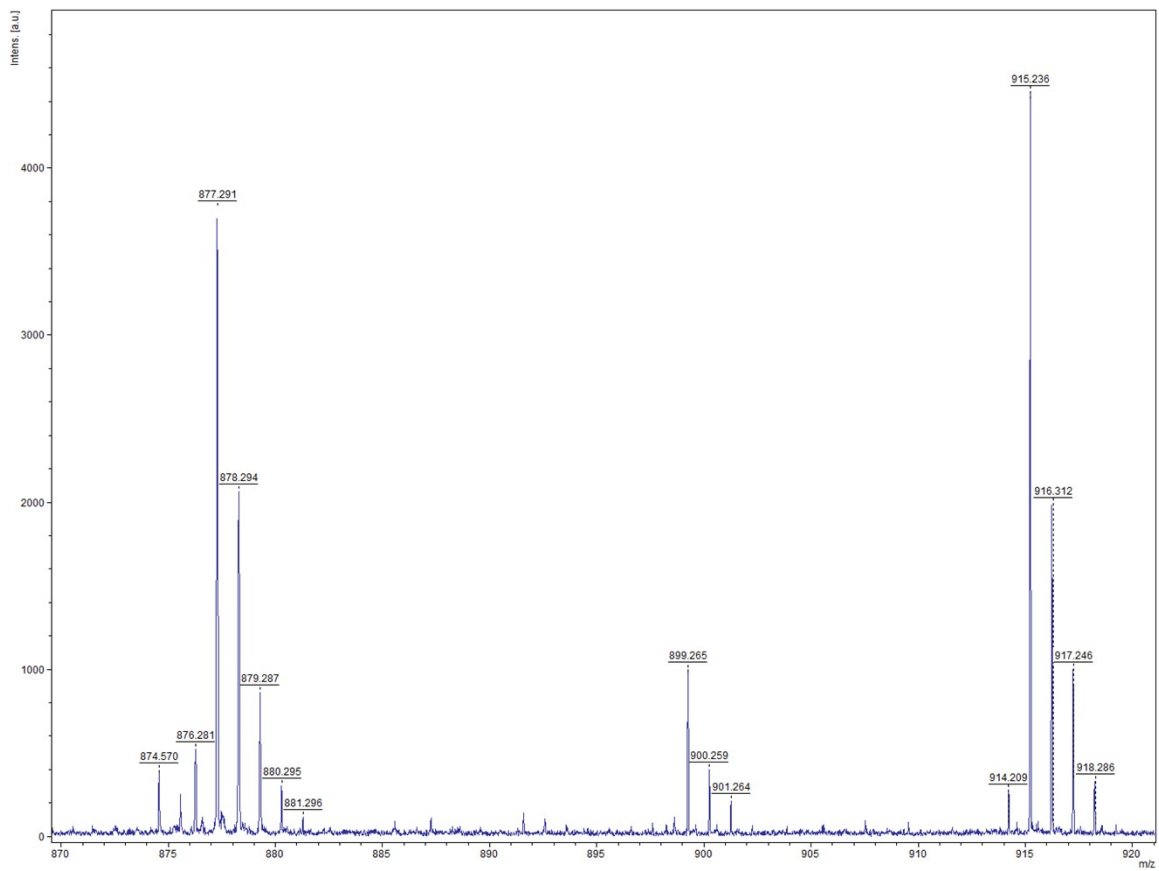


Fig. S16. Mass spectrum of 9c

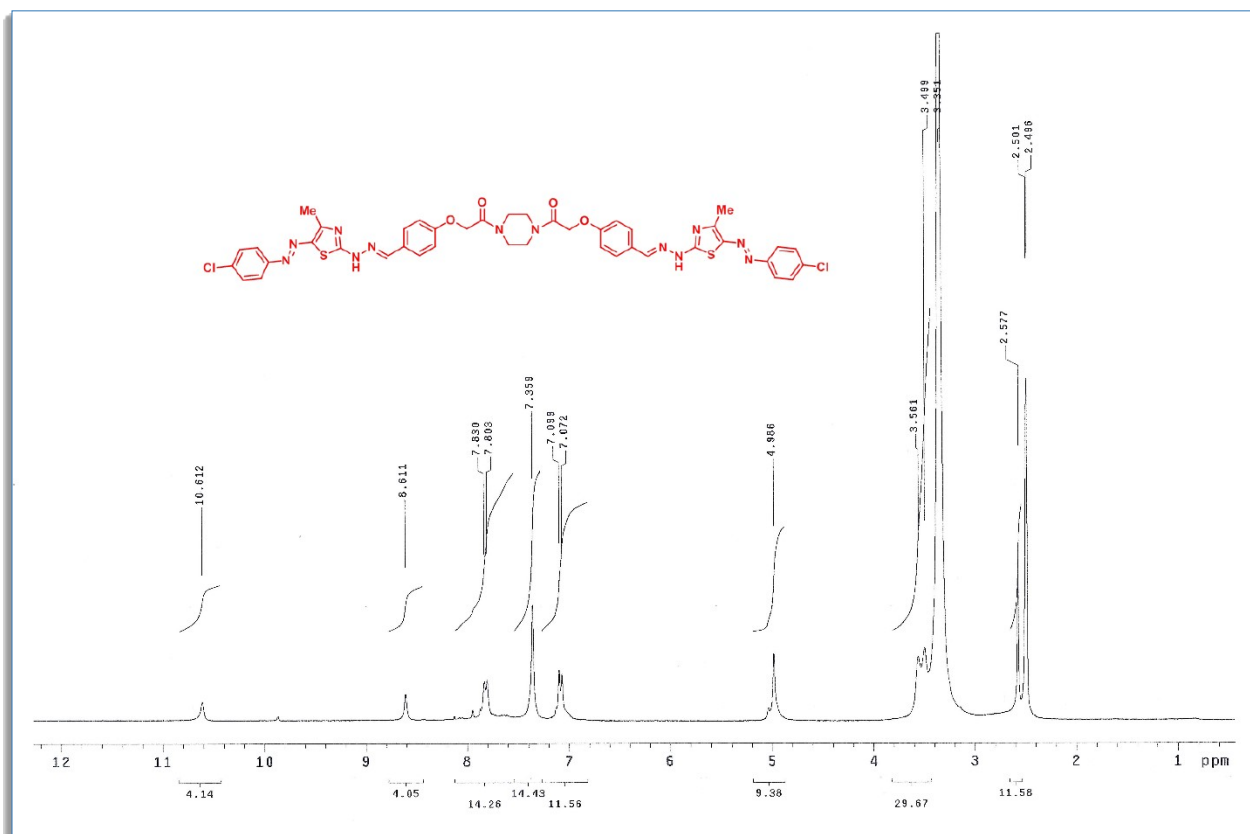


Fig. S17. ¹H NMR spectrum of 9d

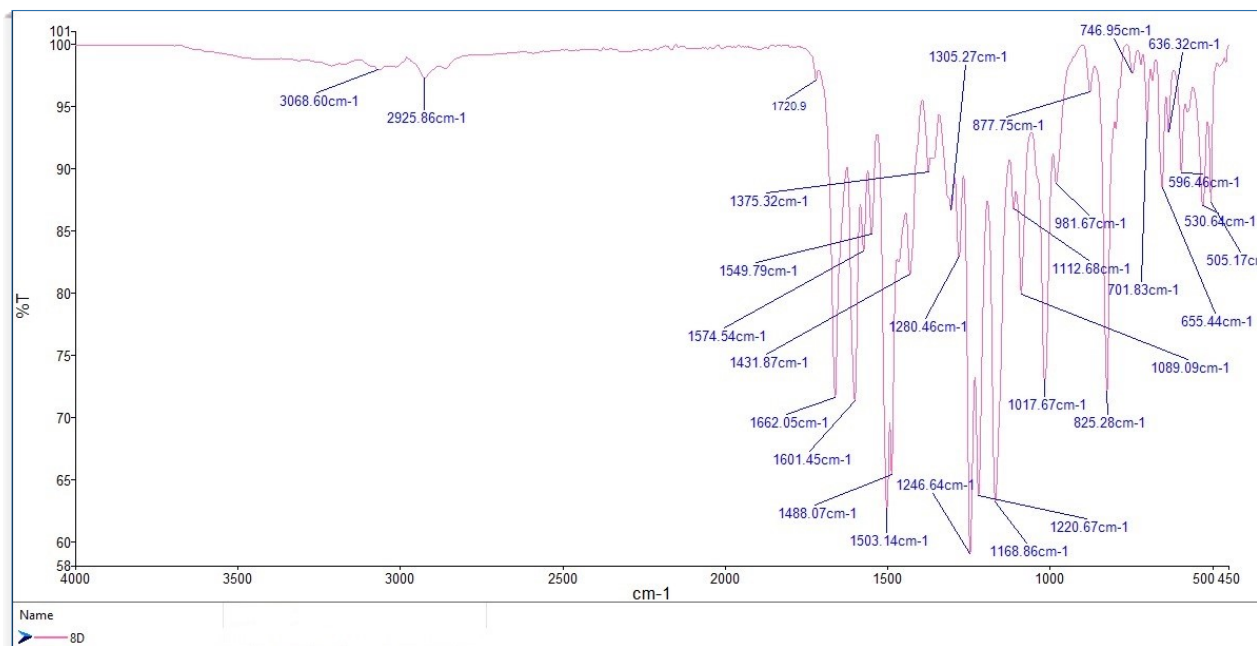


Fig. S18. IR spectrum of 9d

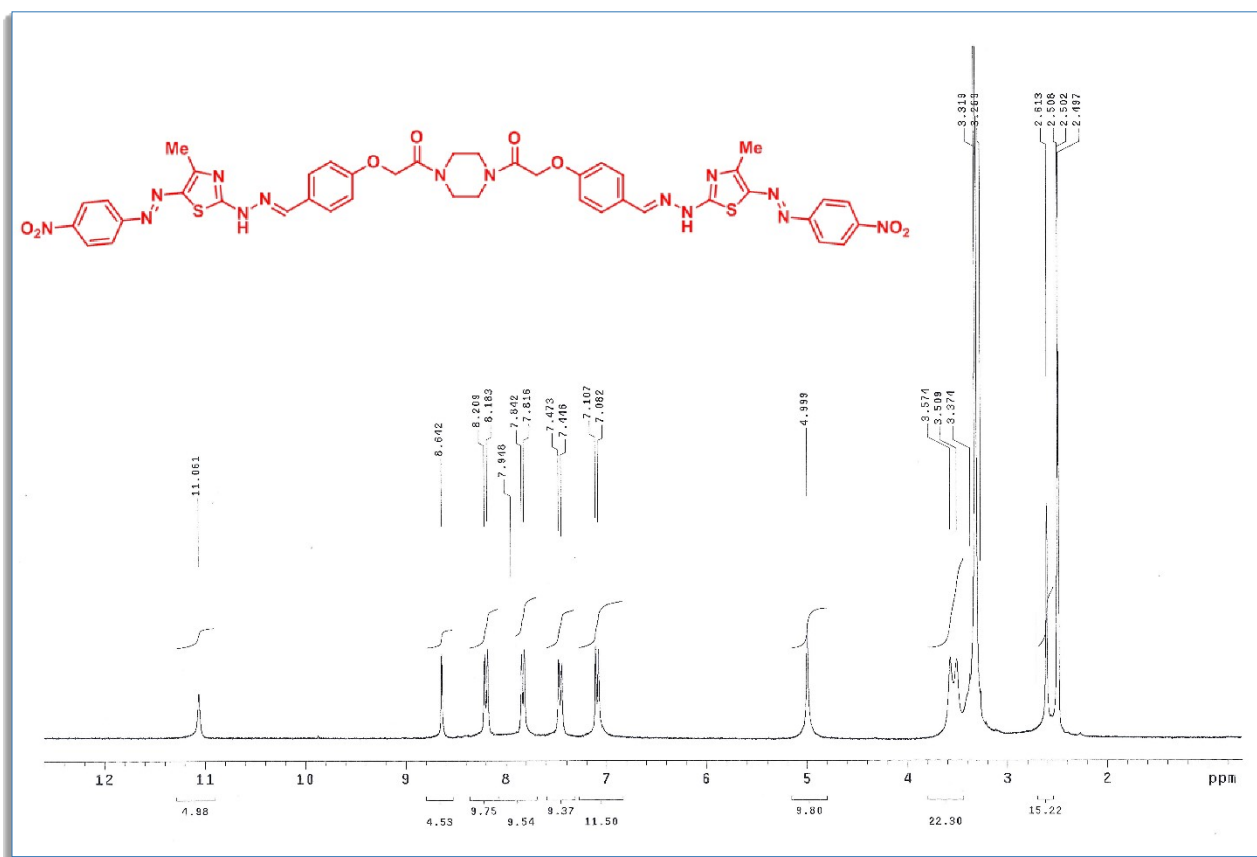


Fig. S19. ¹H NMR spectrum of 9e

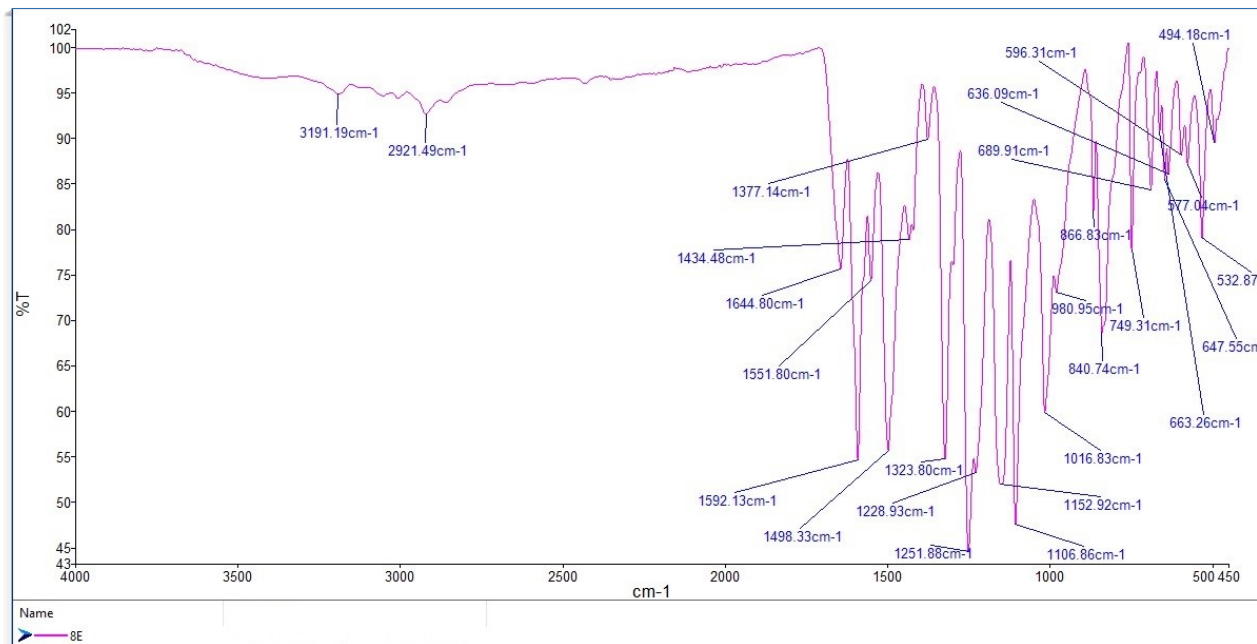


Fig. S20. IR spectrum of 9e

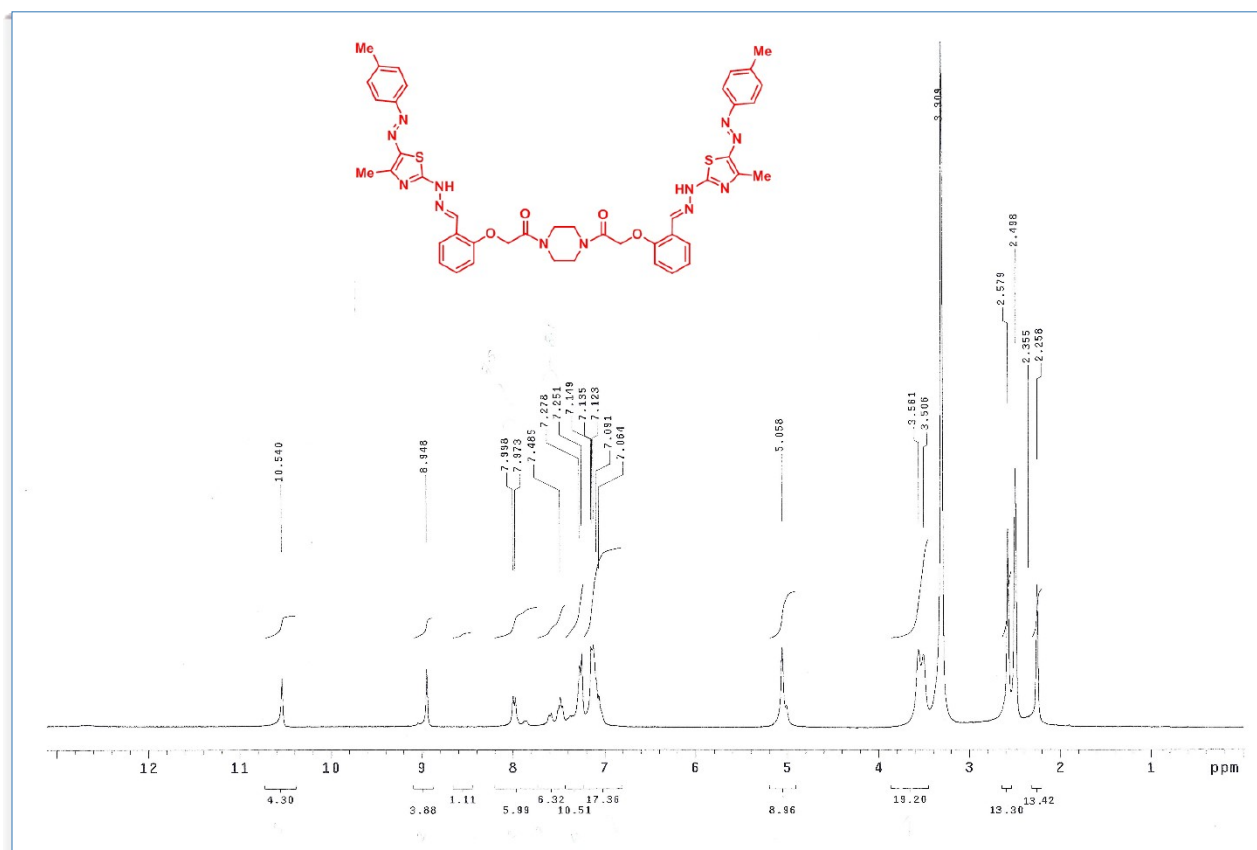


Fig. S21. ¹H NMR spectrum of 9f

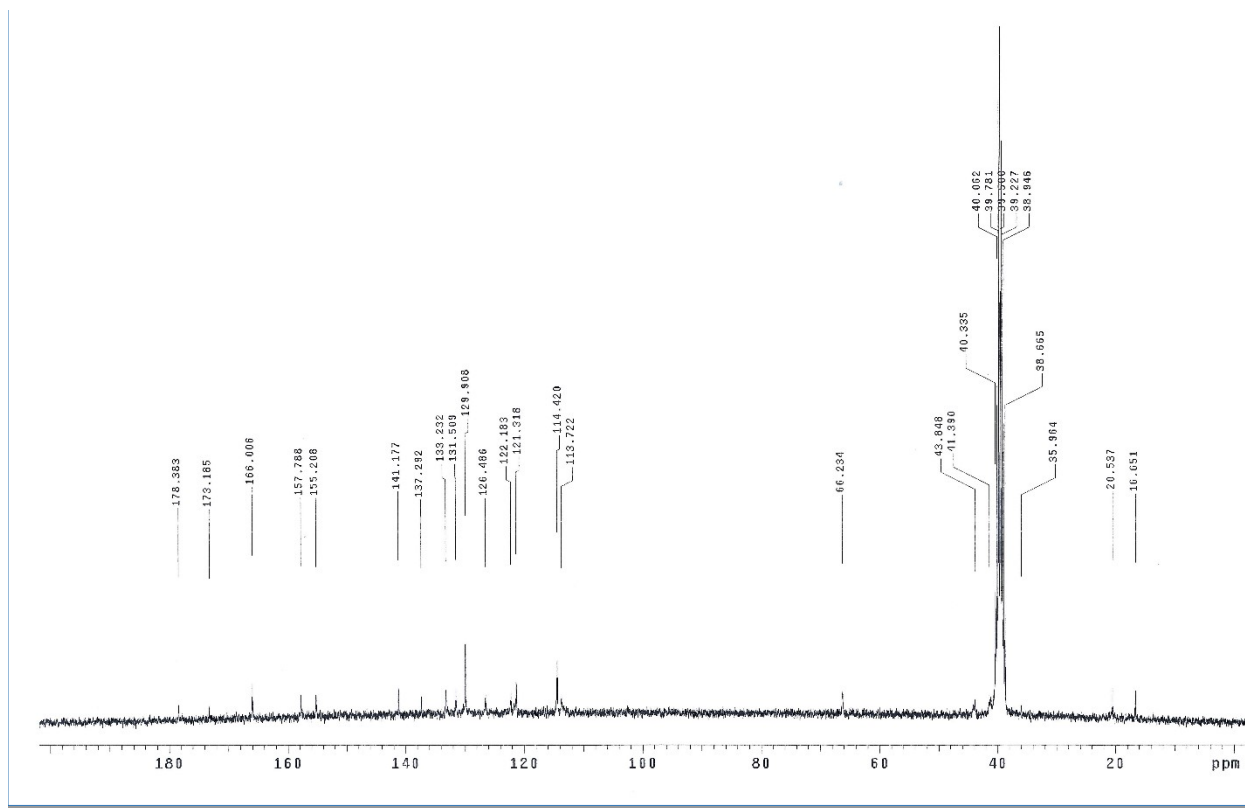


Fig. S22. ^{13}C NMR spectrum of **9f**

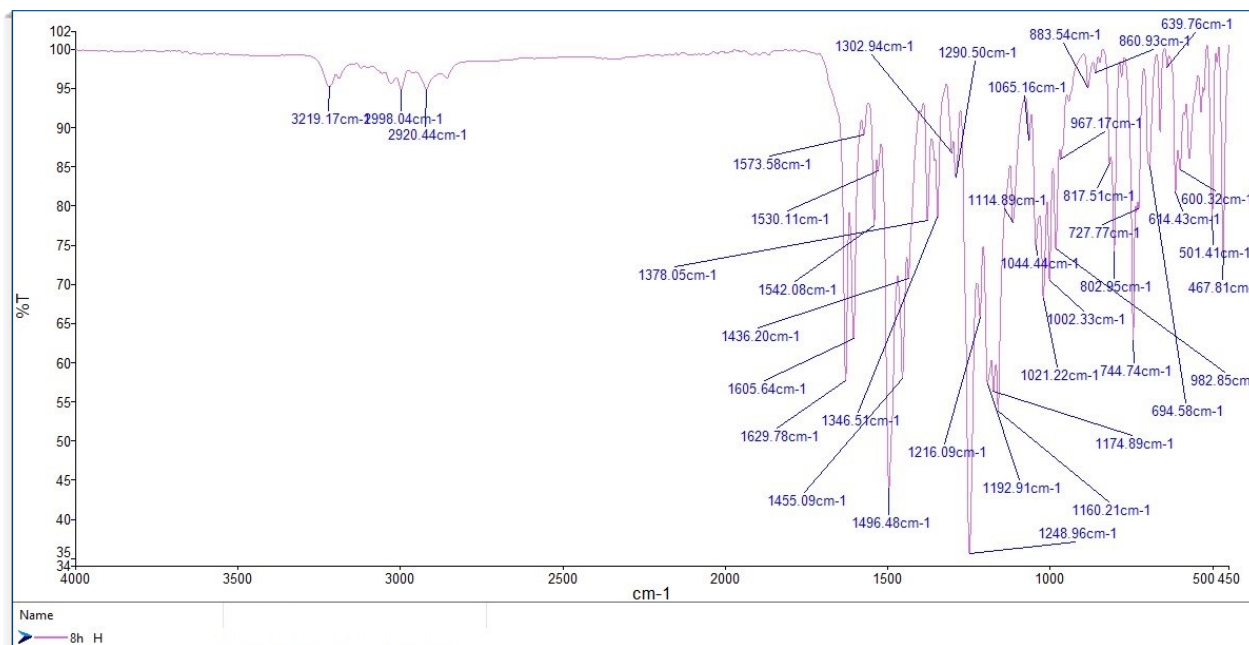


Fig. S23. IR spectrum of **9f**

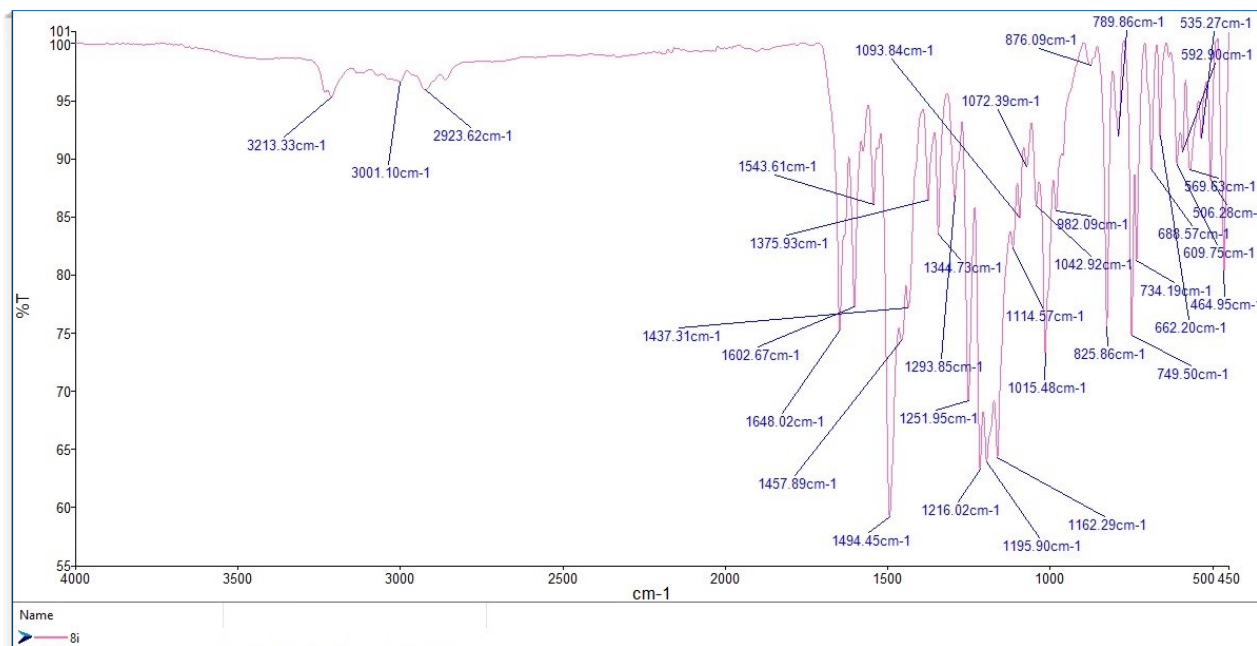


Fig. S26. IR spectrum of 9g

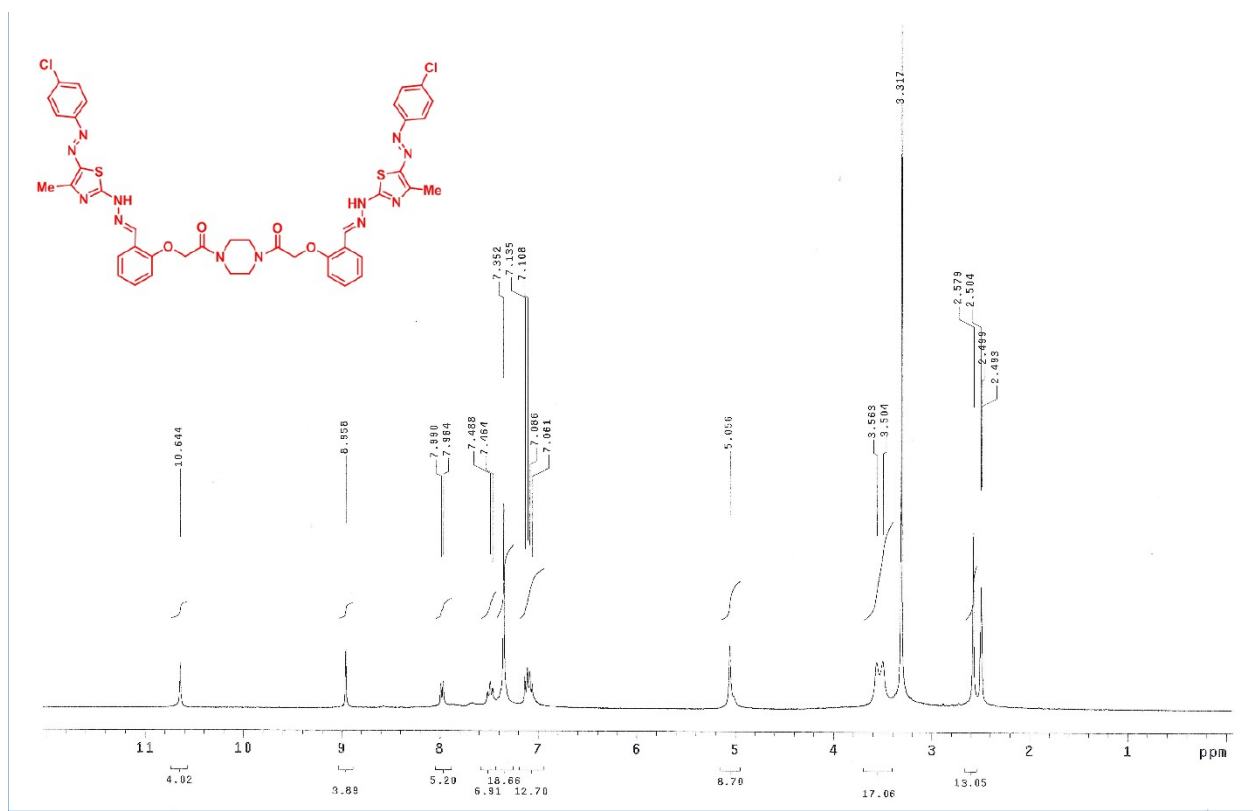


Fig. S27. ¹H NMR spectrum of 9h

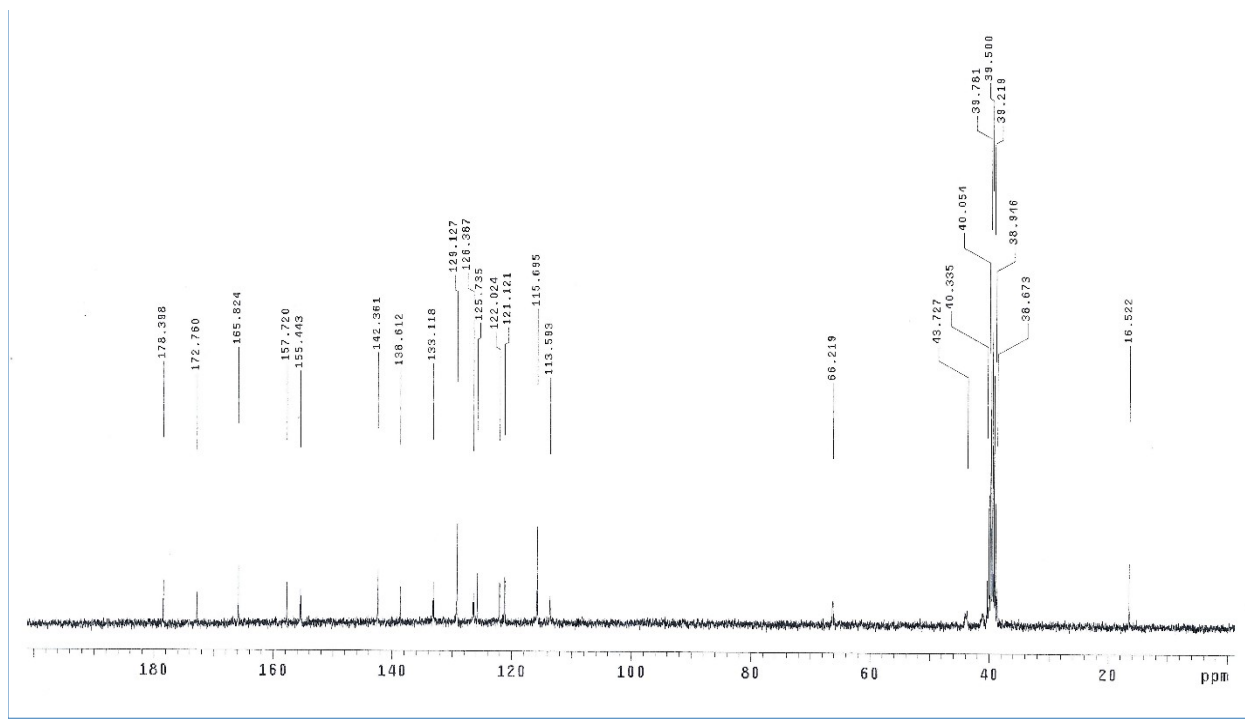


Fig. S28. ^{13}C NMR spectrum of **9h**

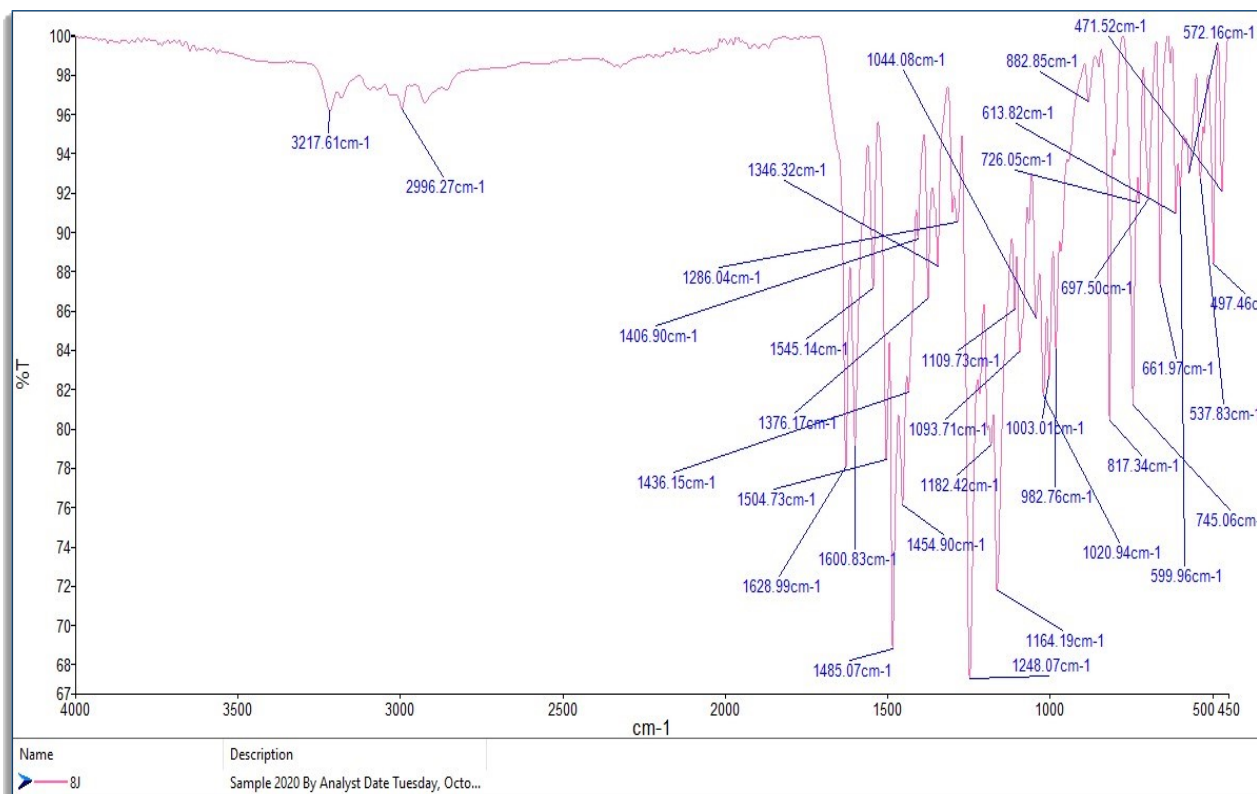


Fig. S29. IR spectrum of **9h**

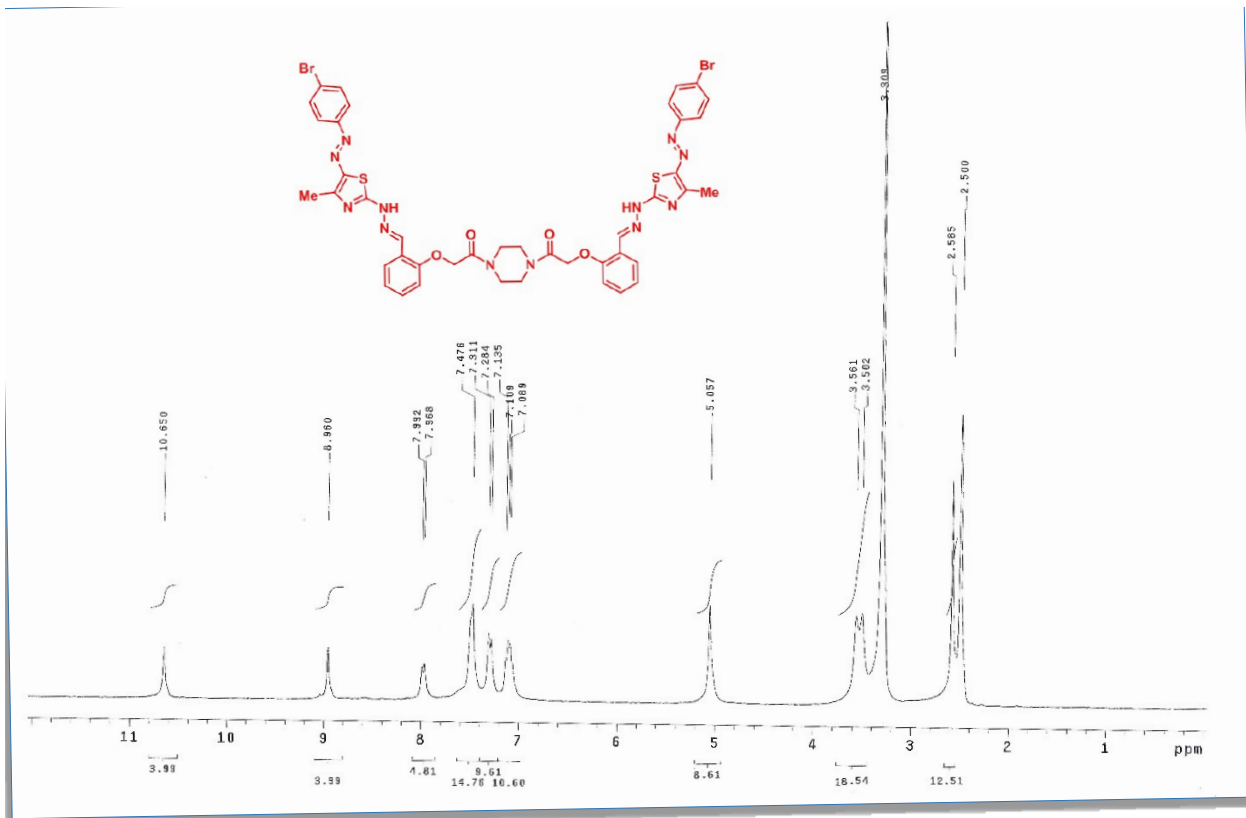


Fig. S30. ¹H NMR spectrum of **9i**

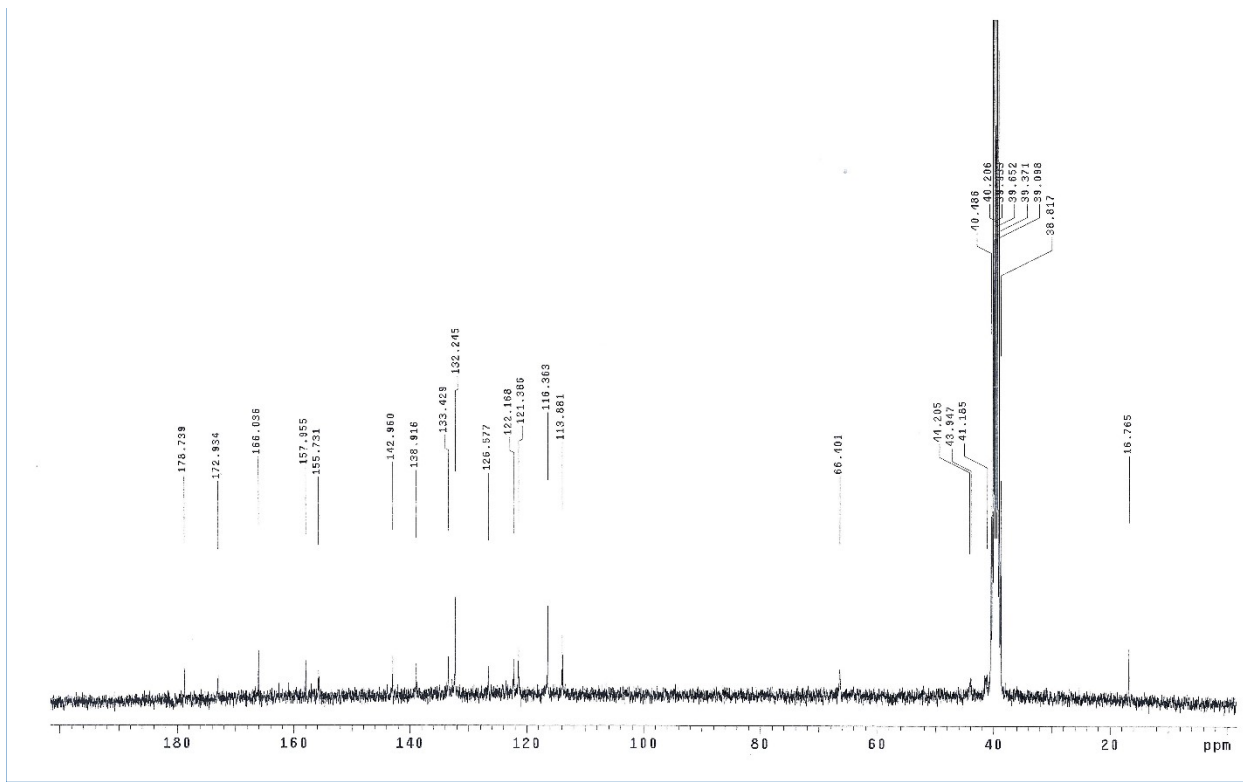


Fig. S31. ¹³C NMR spectrum of **9i**

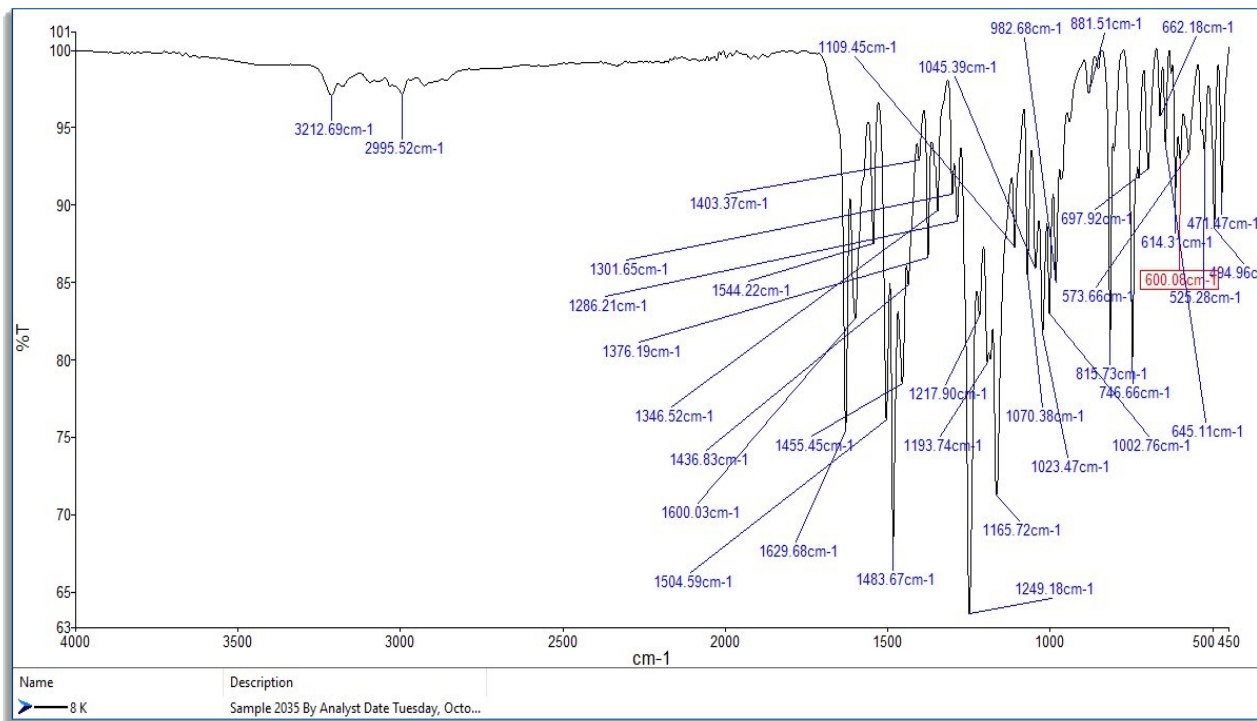


Fig. S32. IR spectrum of 9i

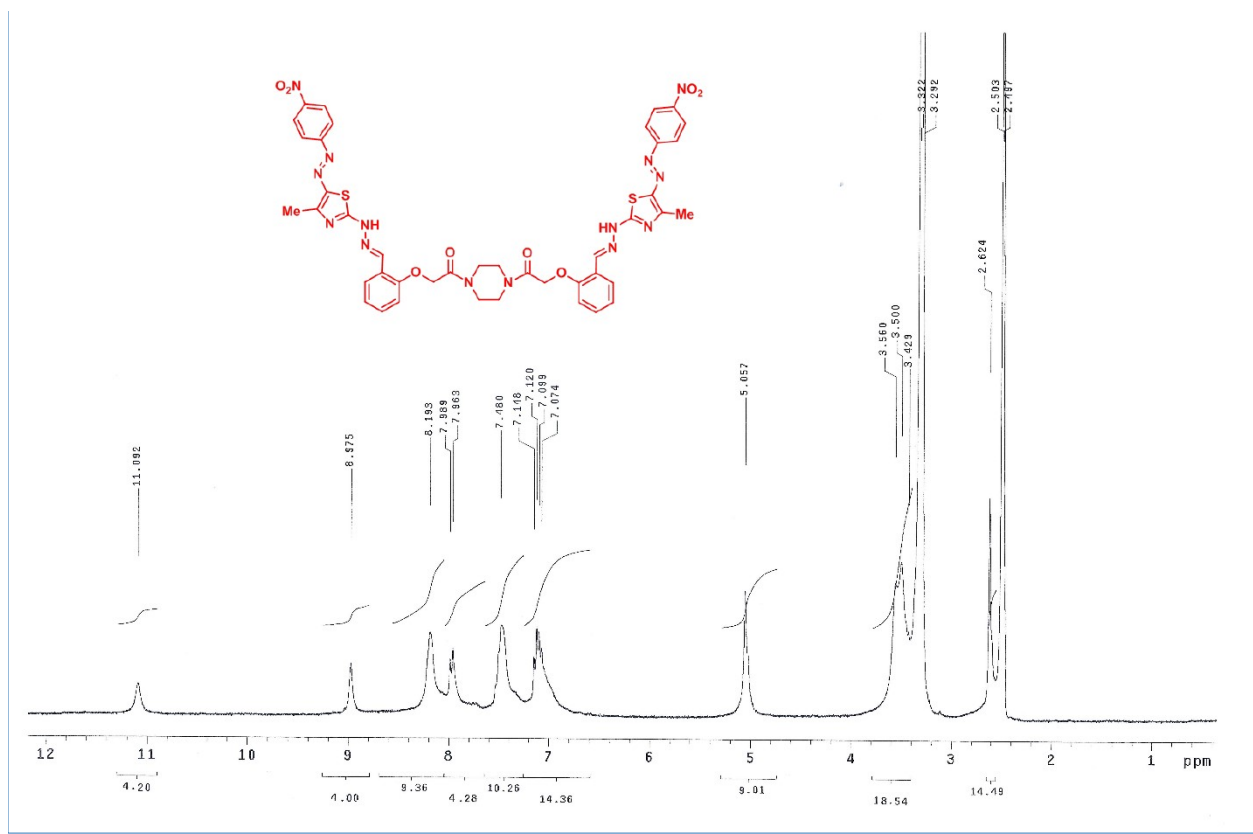


Fig. S33. ¹H NMR spectrum of 9j

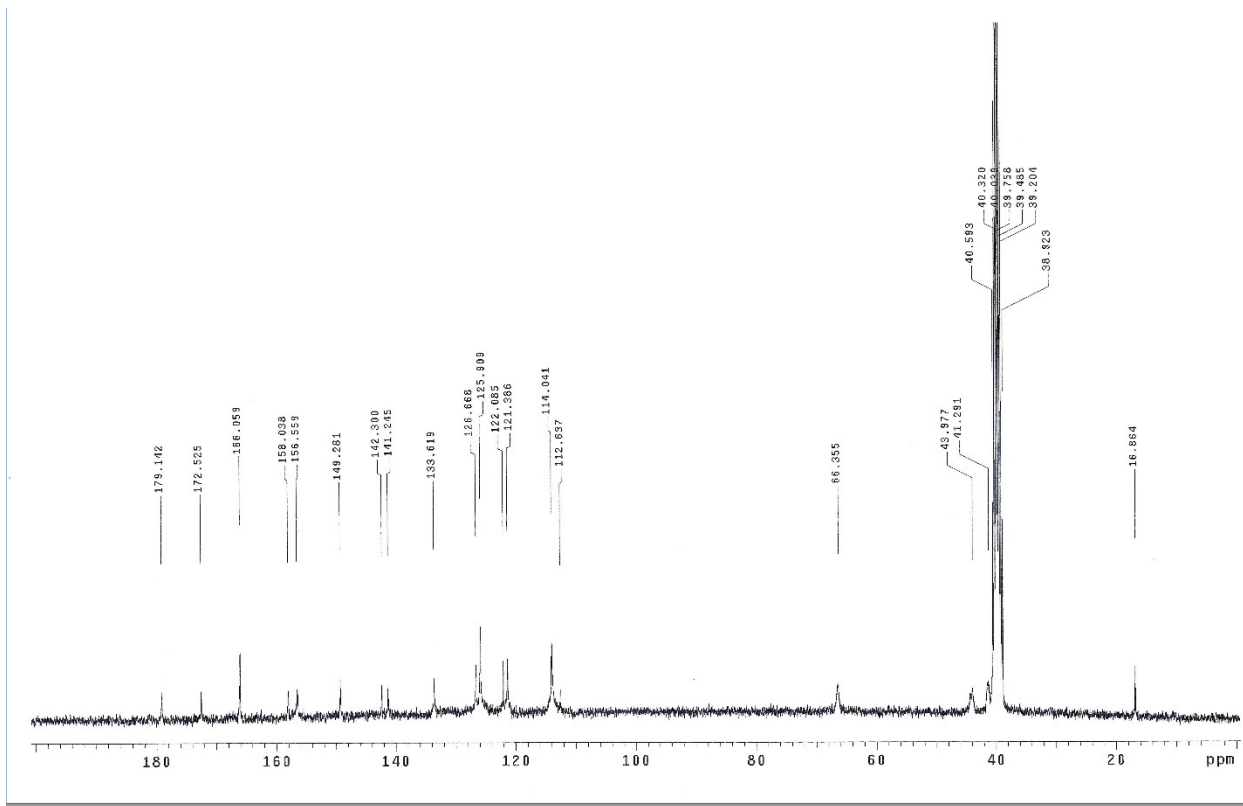


Fig. S34. ^{13}C NMR spectrum of **9j**

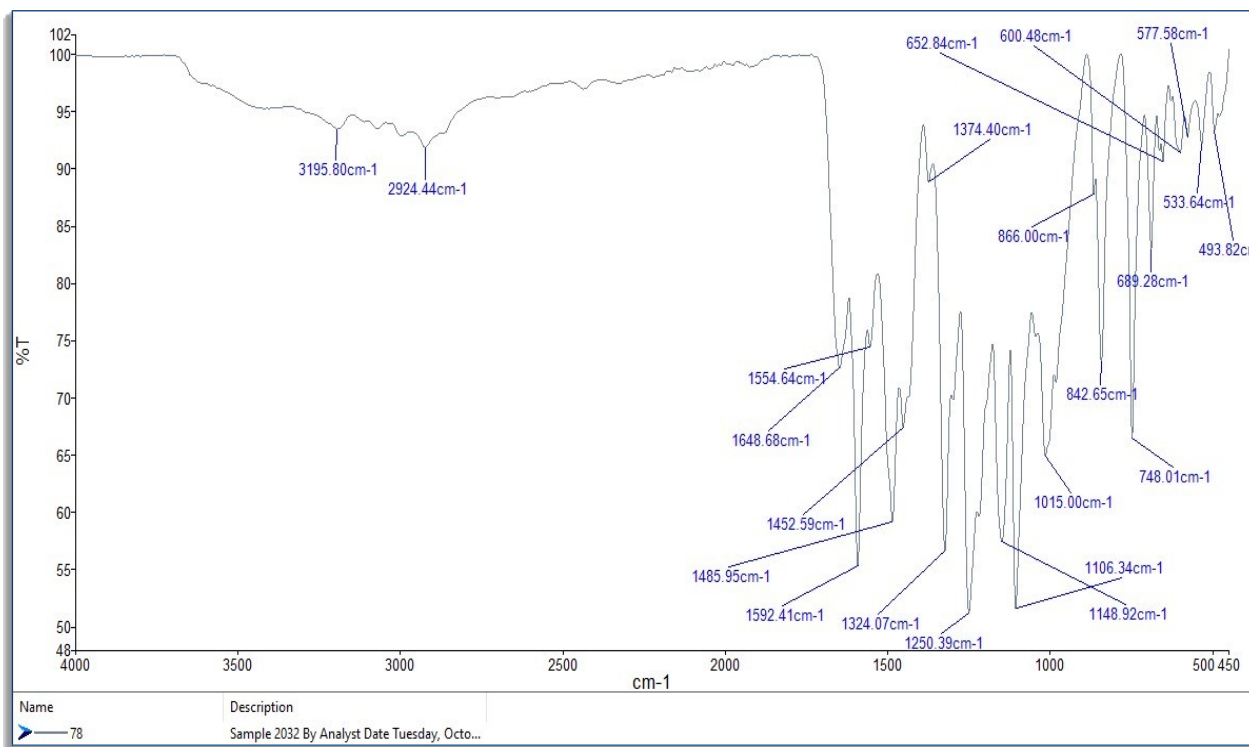


Fig. S35. IR spectrum of **9j**

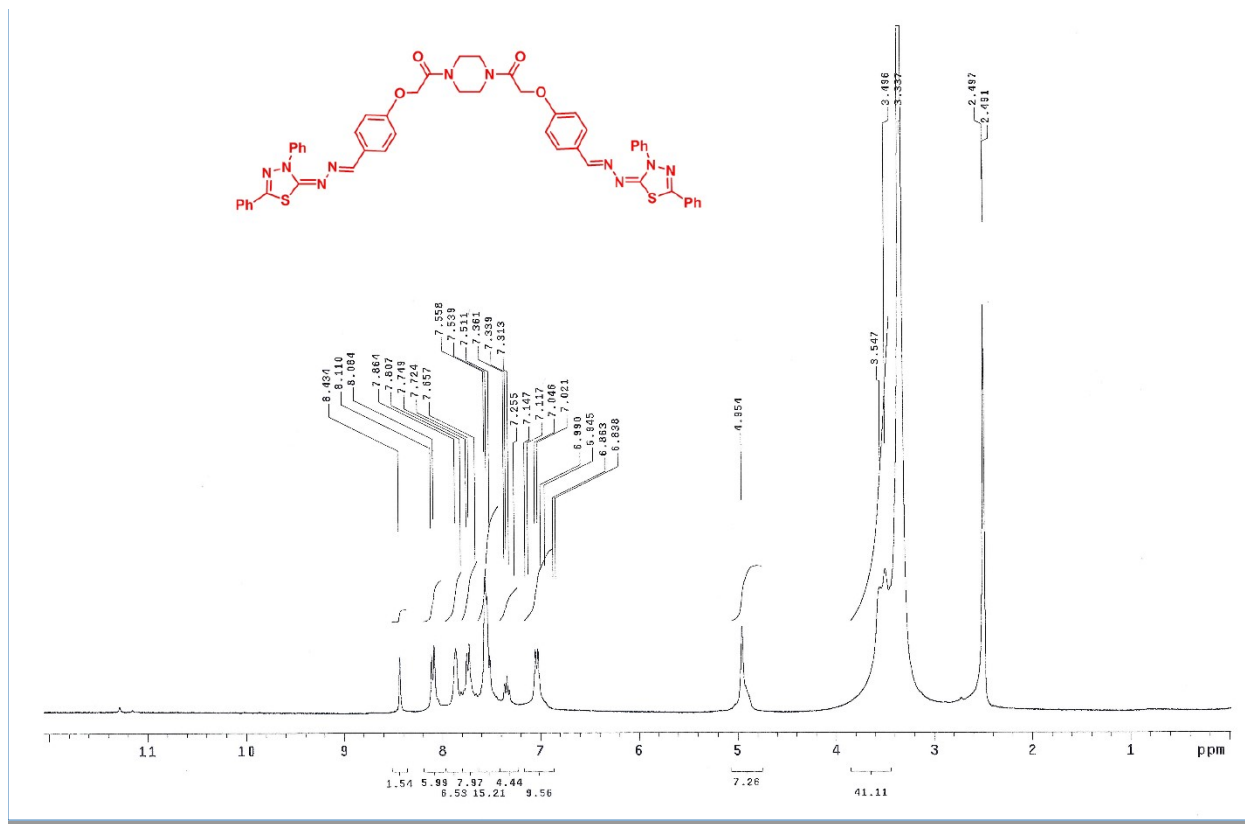


Fig. S36. ¹H NMR spectrum of 13a

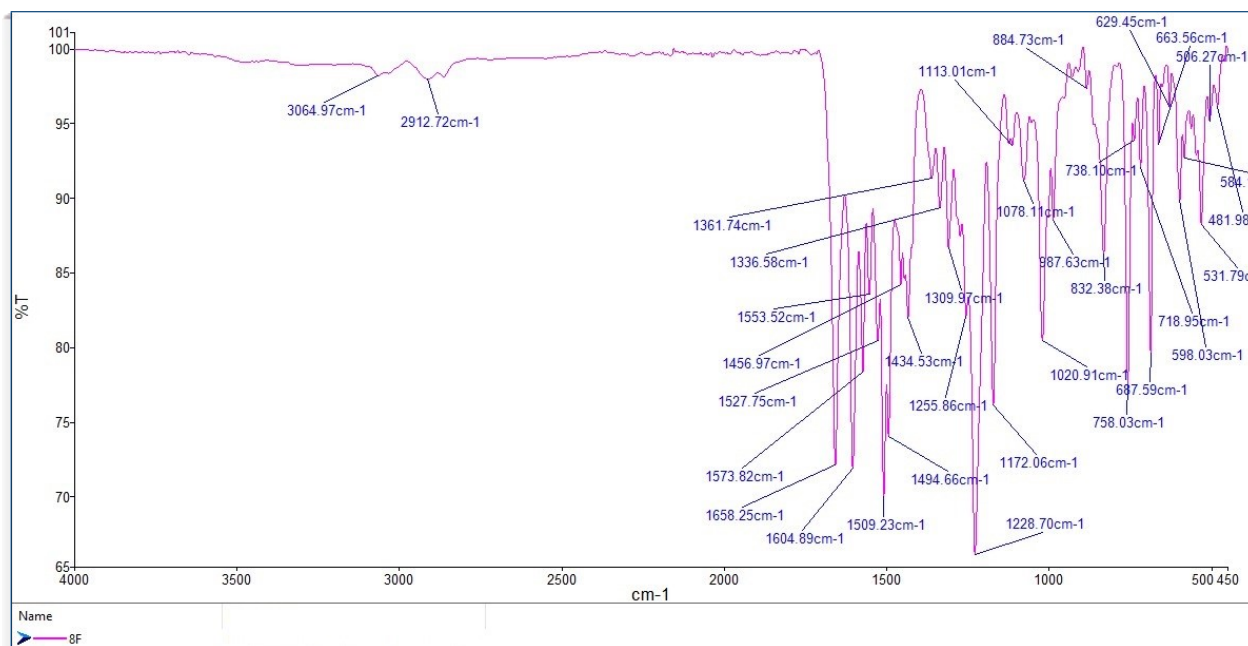


Fig. S37. IR spectrum of 13a

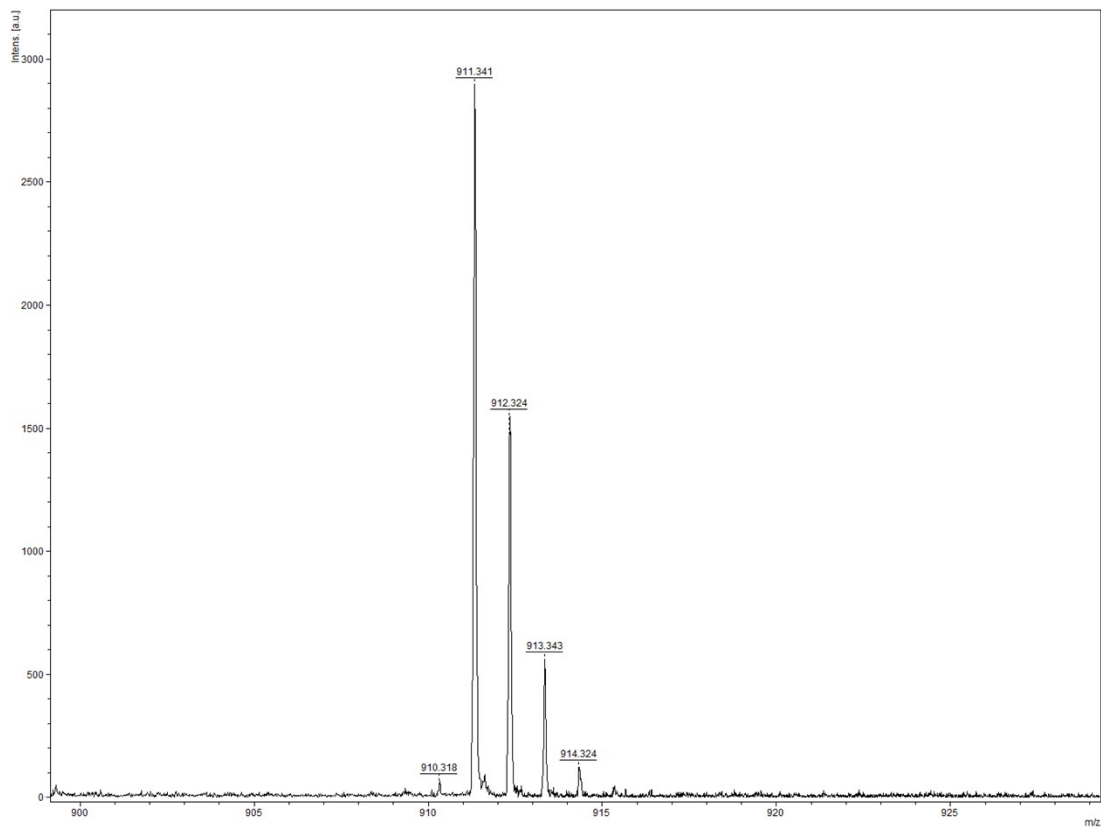


Fig. S38. Mass spectrum of **13a**

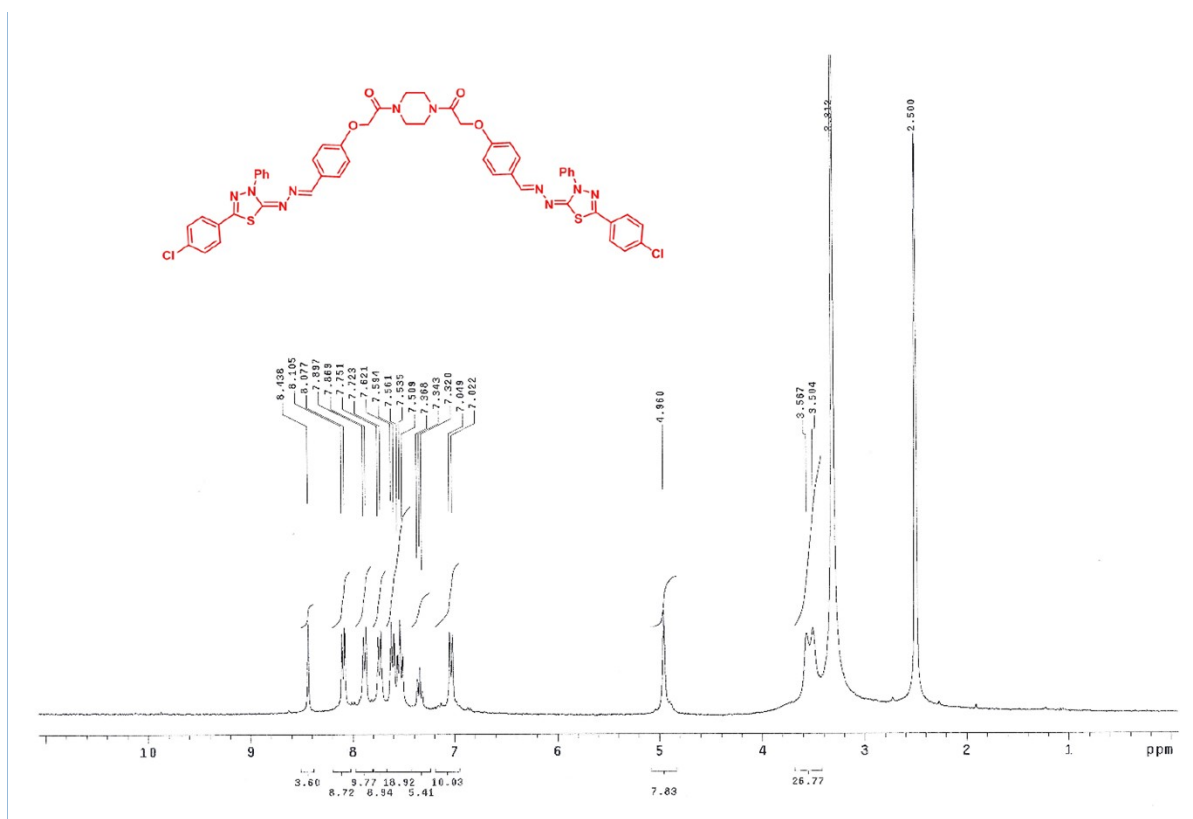


Fig. S39. ¹H NMR spectrum of **13b**

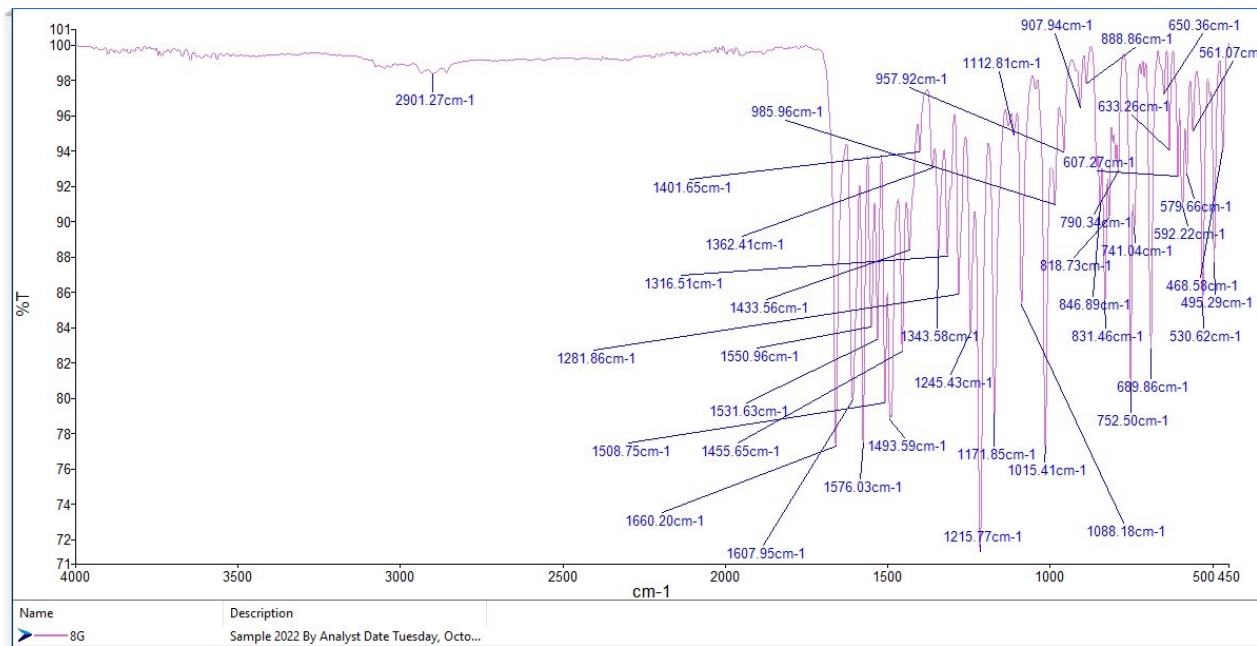


Fig. S40. IR spectrum of **13b**

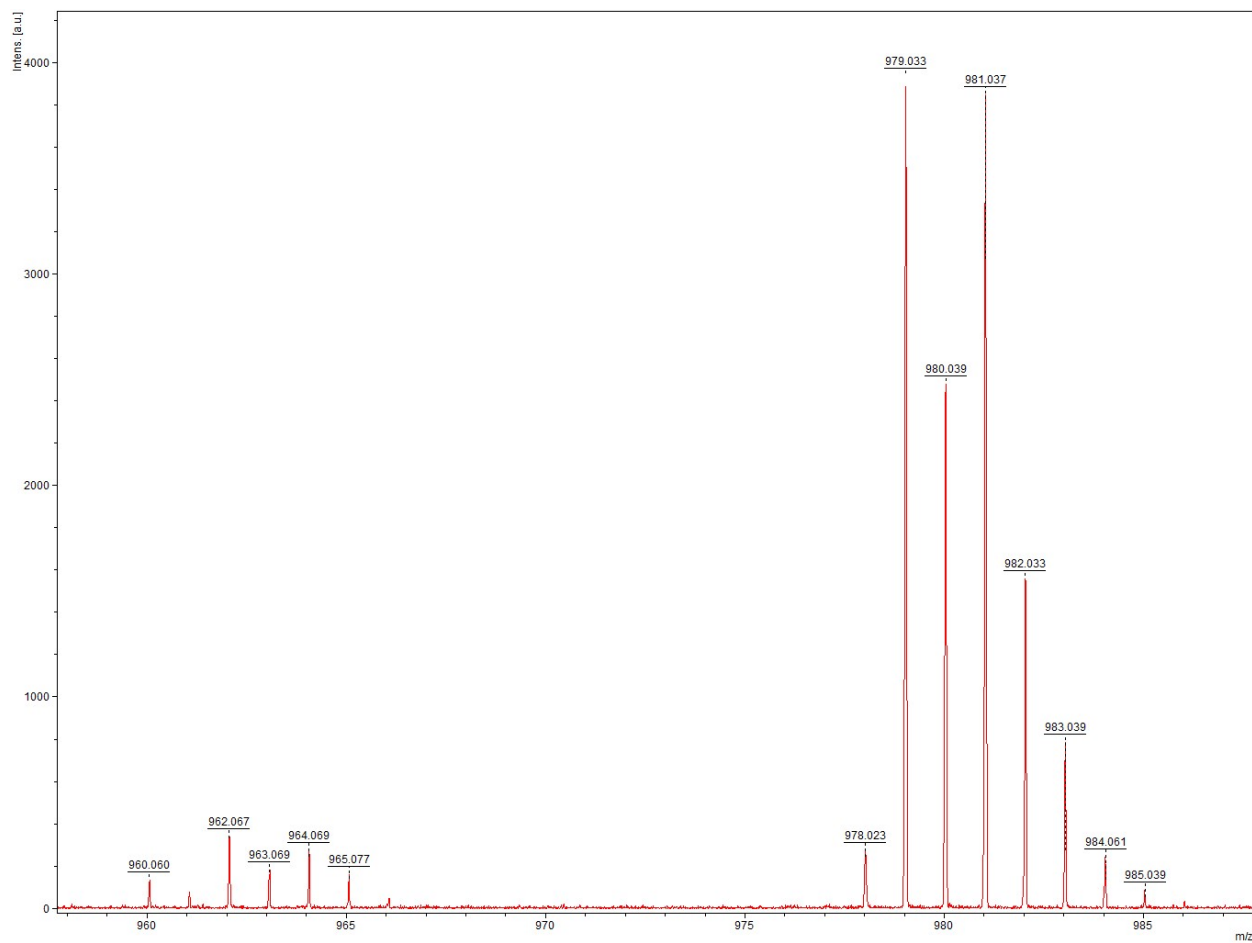


Fig. S41. Mass spectrum of **13b**

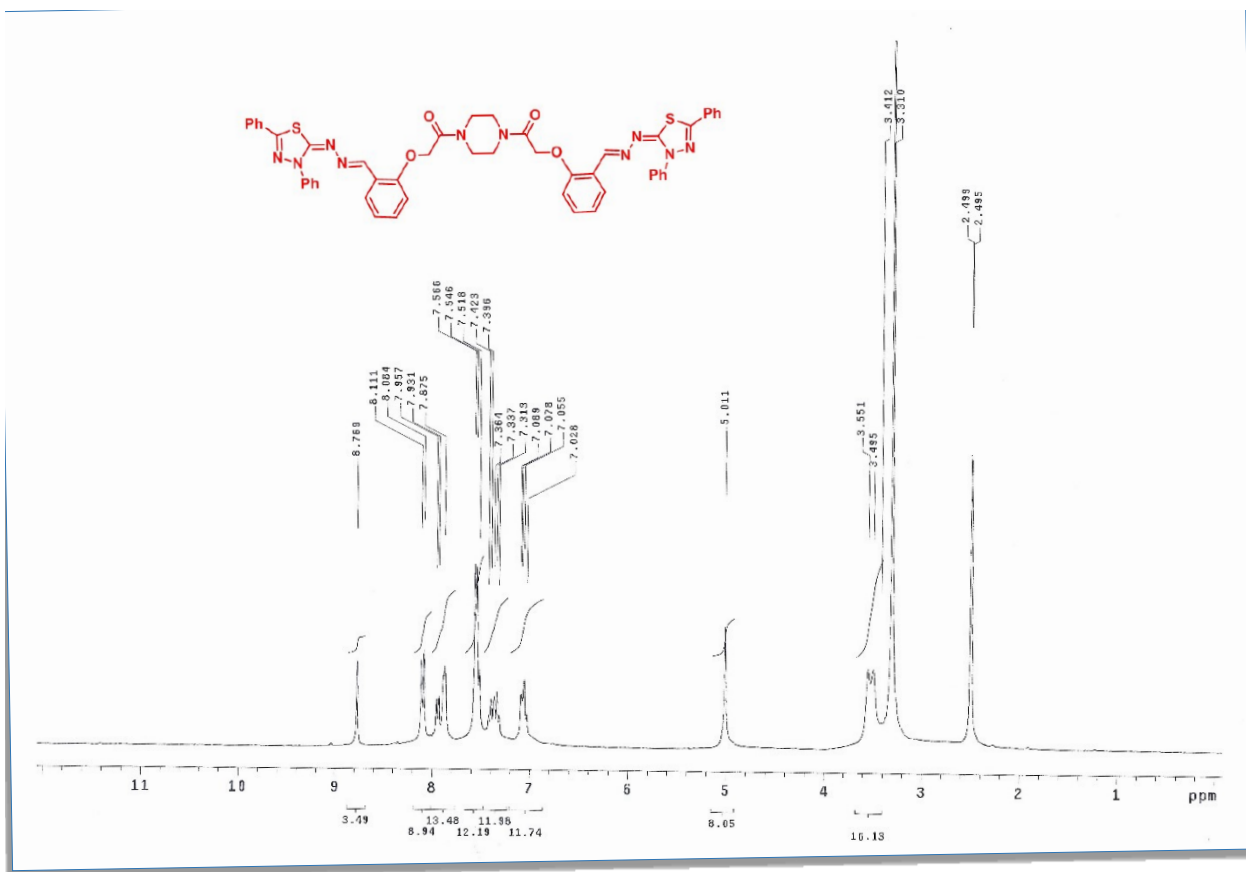


Fig. S42. ¹H NMR spectrum of 13c

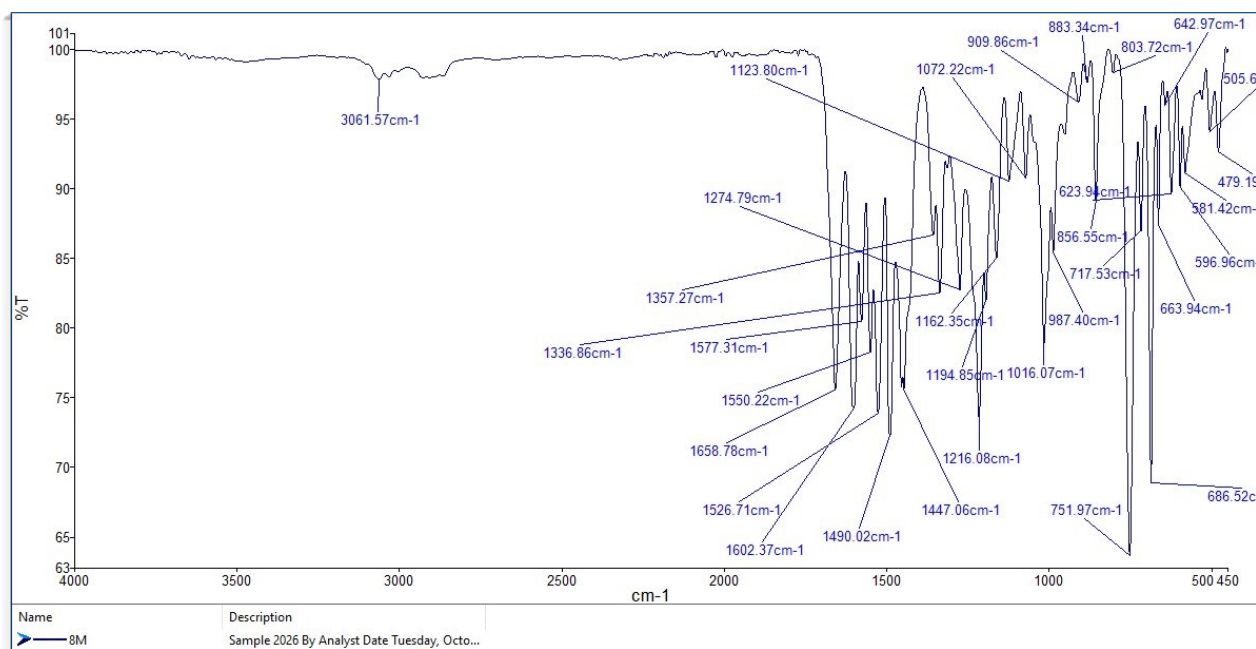


Fig. S43. IR spectrum of 13c

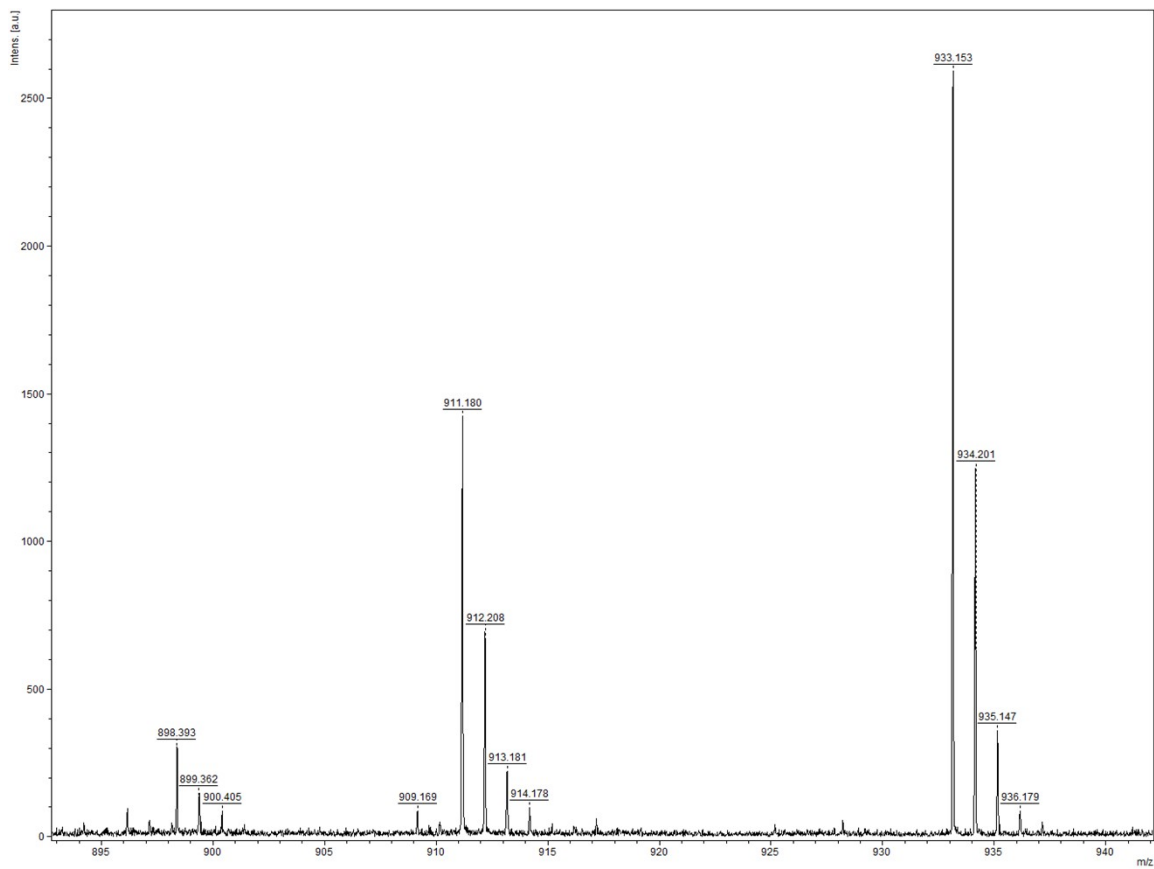


Fig. S44. Mass spectrum of 13c

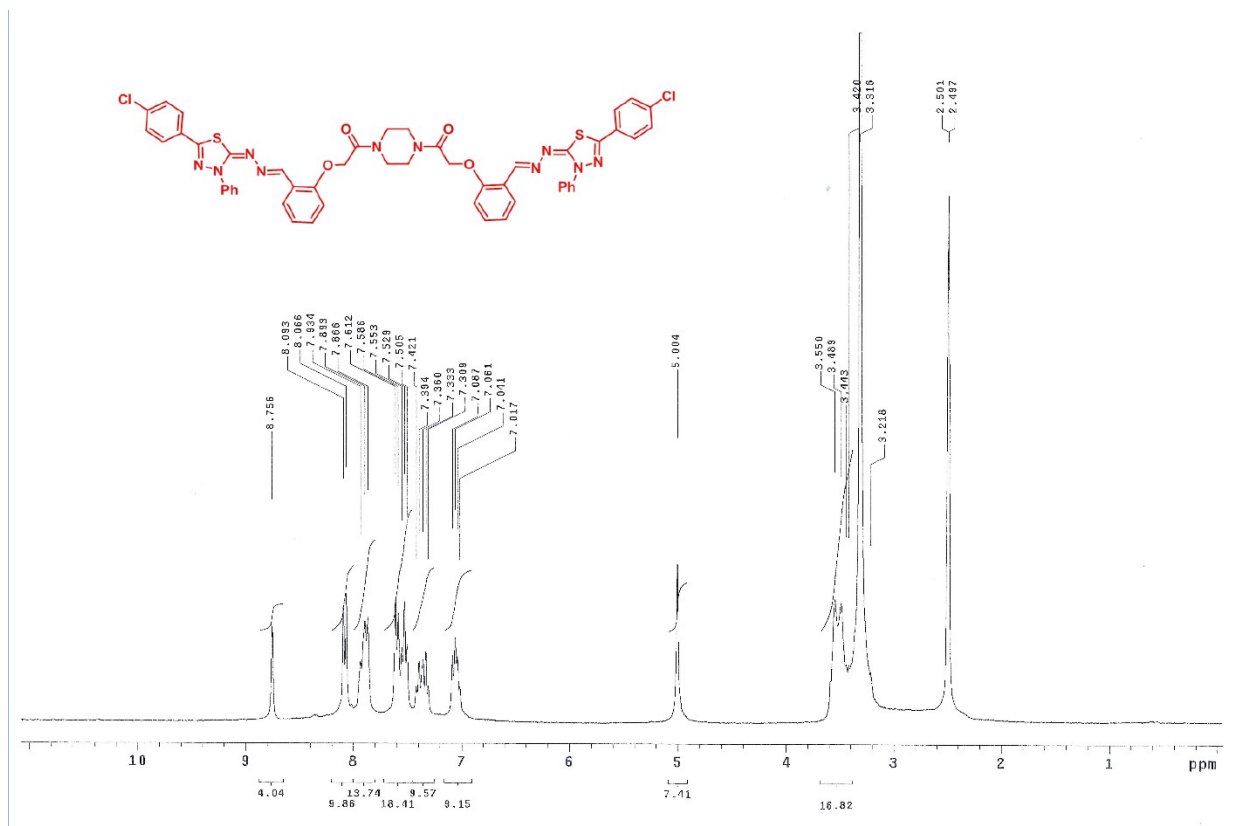


Fig. S45. ¹H NMR spectrum of 13d

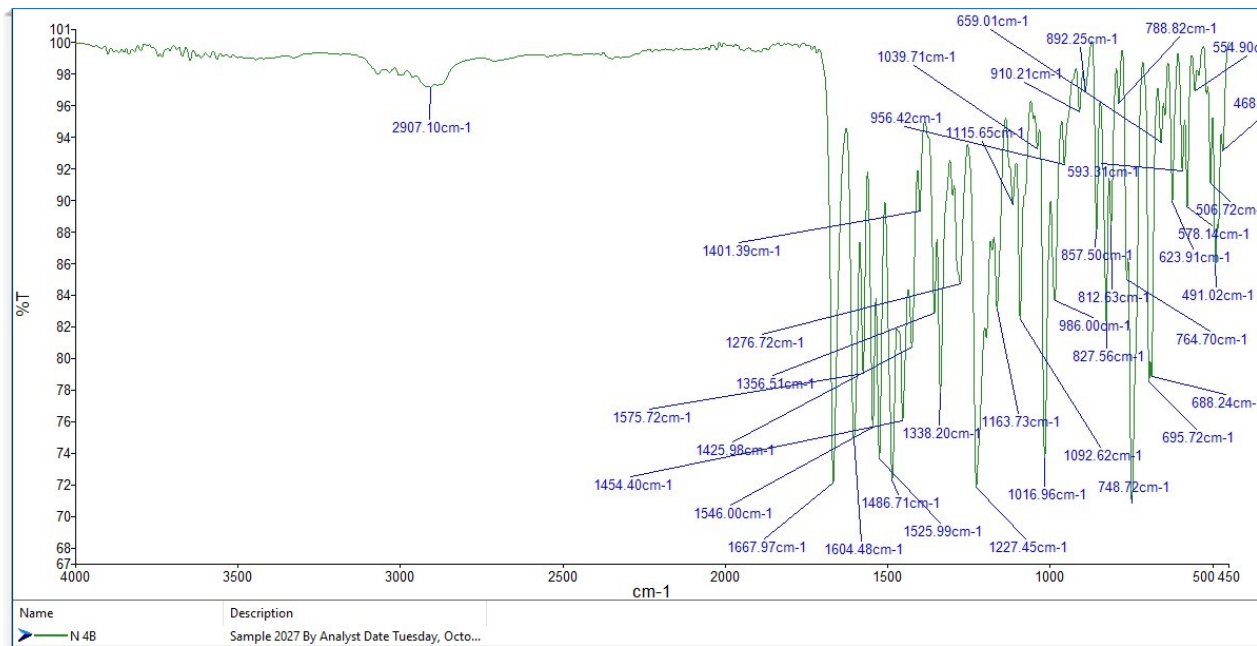


Fig. S46. IR spectrum of 13d

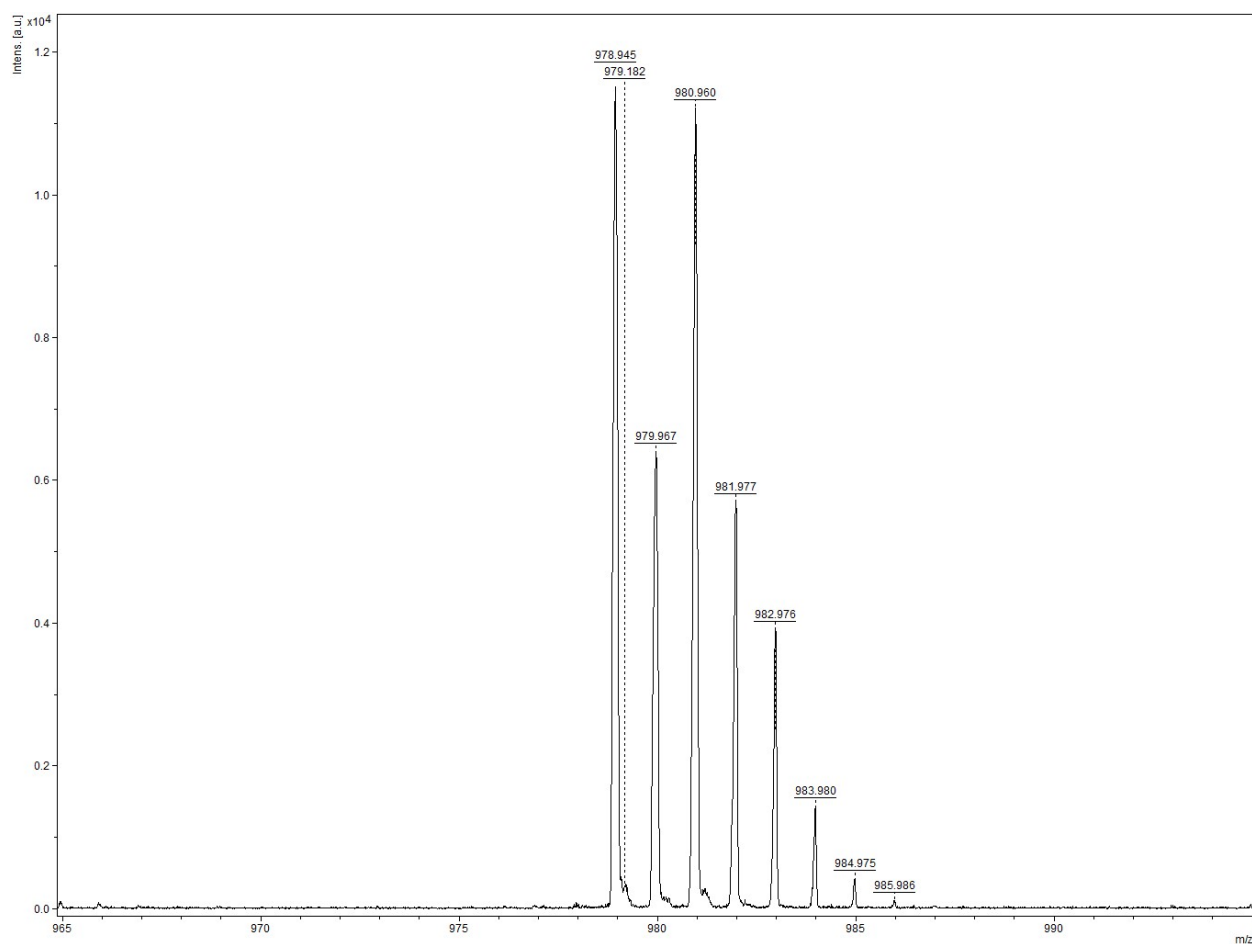


Fig. S47. Mass spectrum of 13d

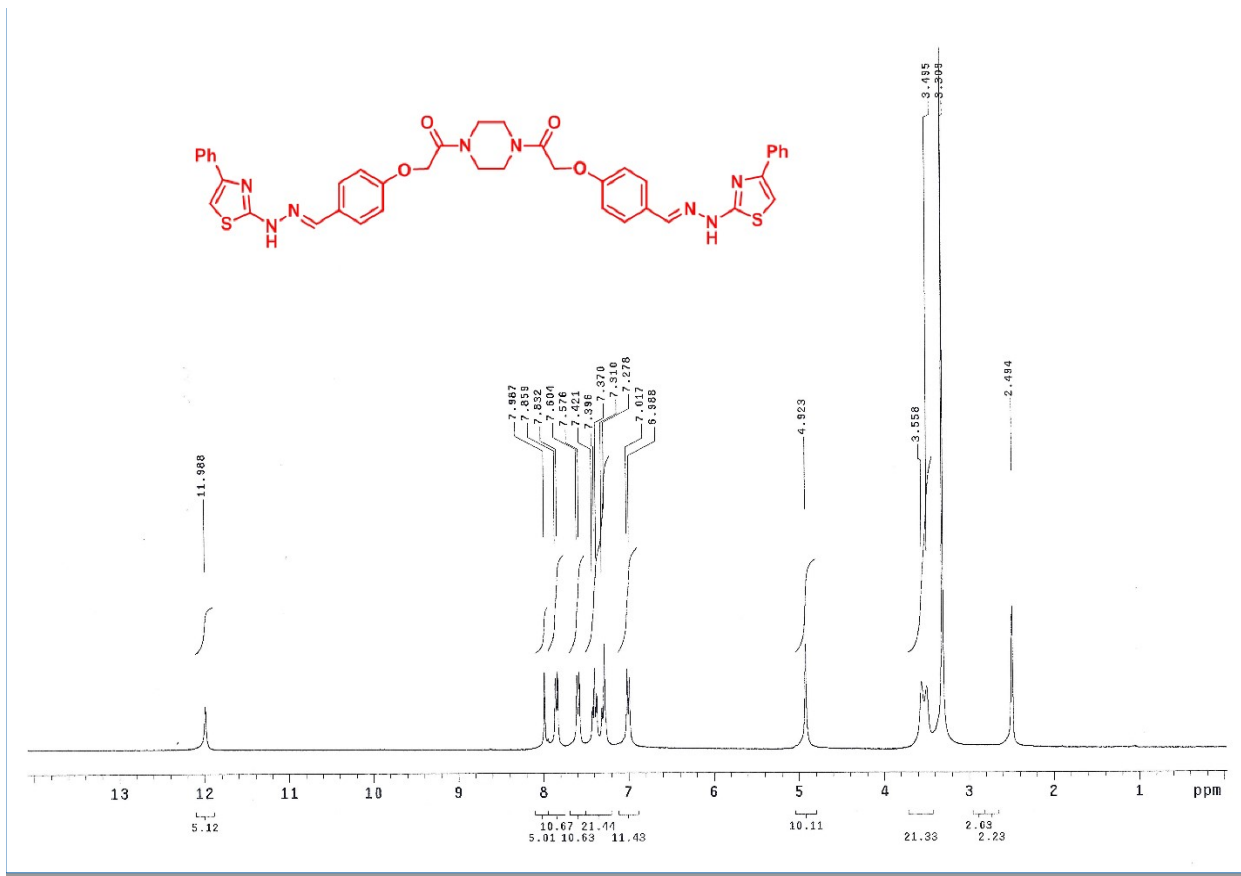


Fig. S48. ¹H NMR spectrum of 15a

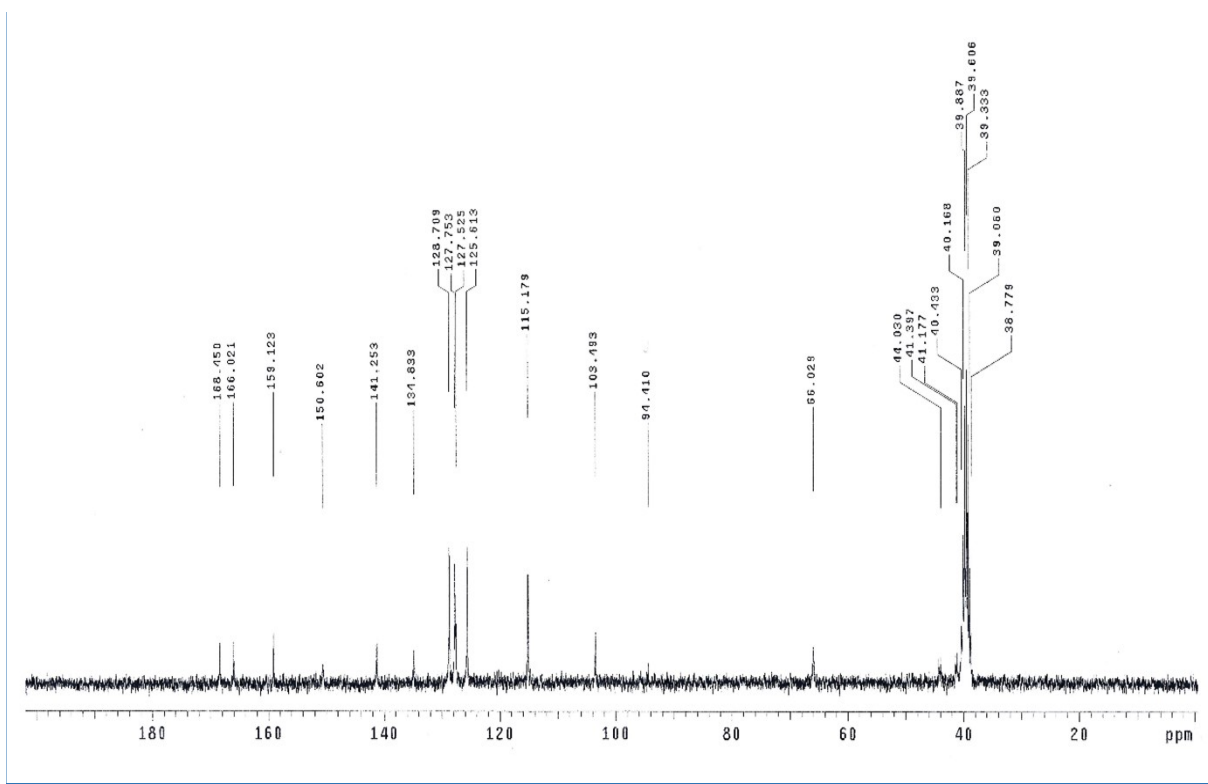


Fig. S49. ¹³C NMR spectrum of 15a

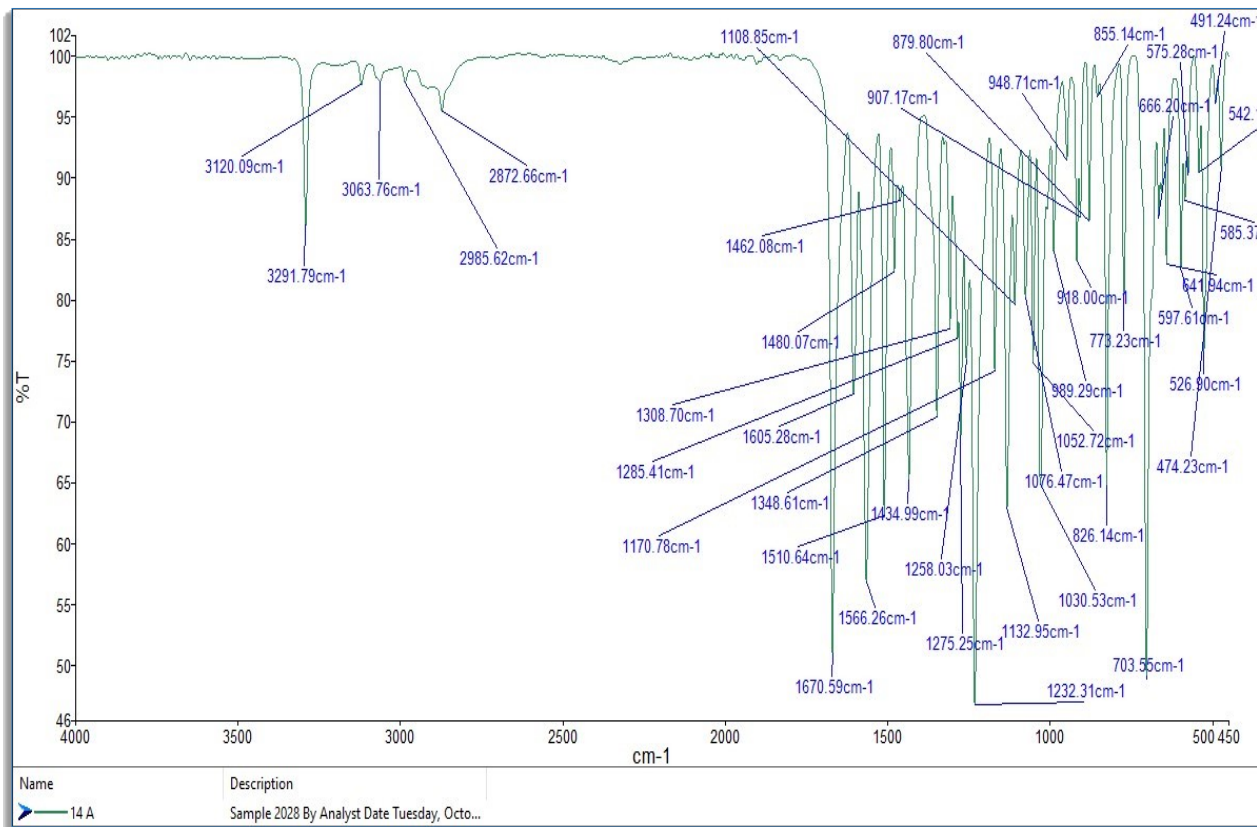


Fig. S50. IR spectrum of **15a**

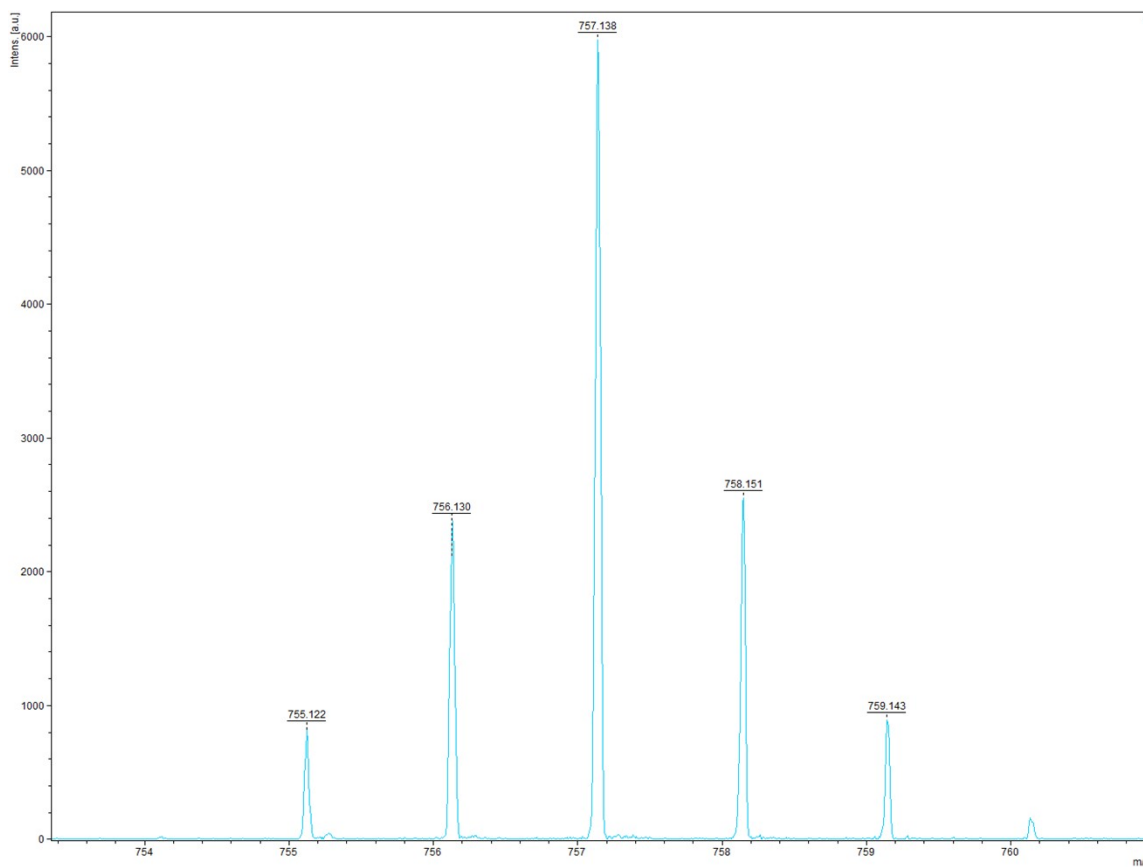


Fig. S51. Mass spectrum of **15a**

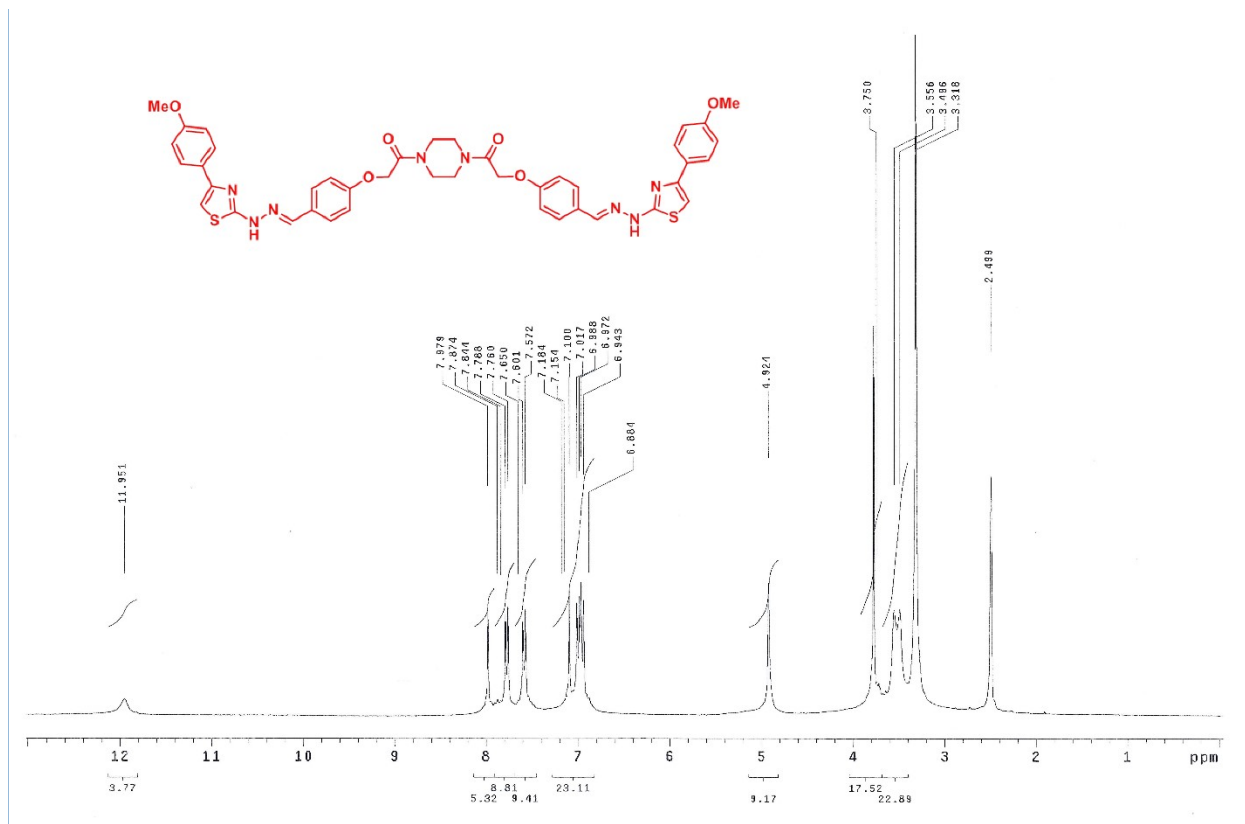


Fig. S52. ¹H NMR spectrum of **15b**

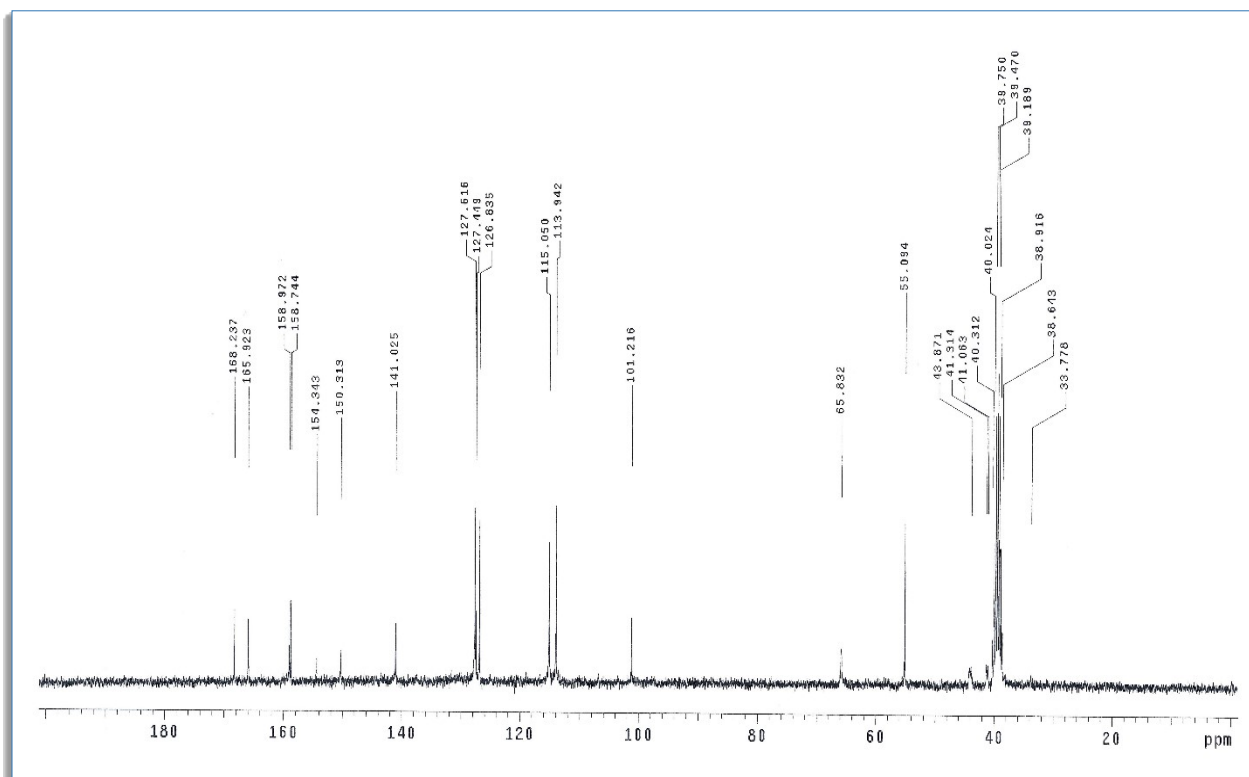


Fig. S53. ¹³C NMR spectrum of **15b**

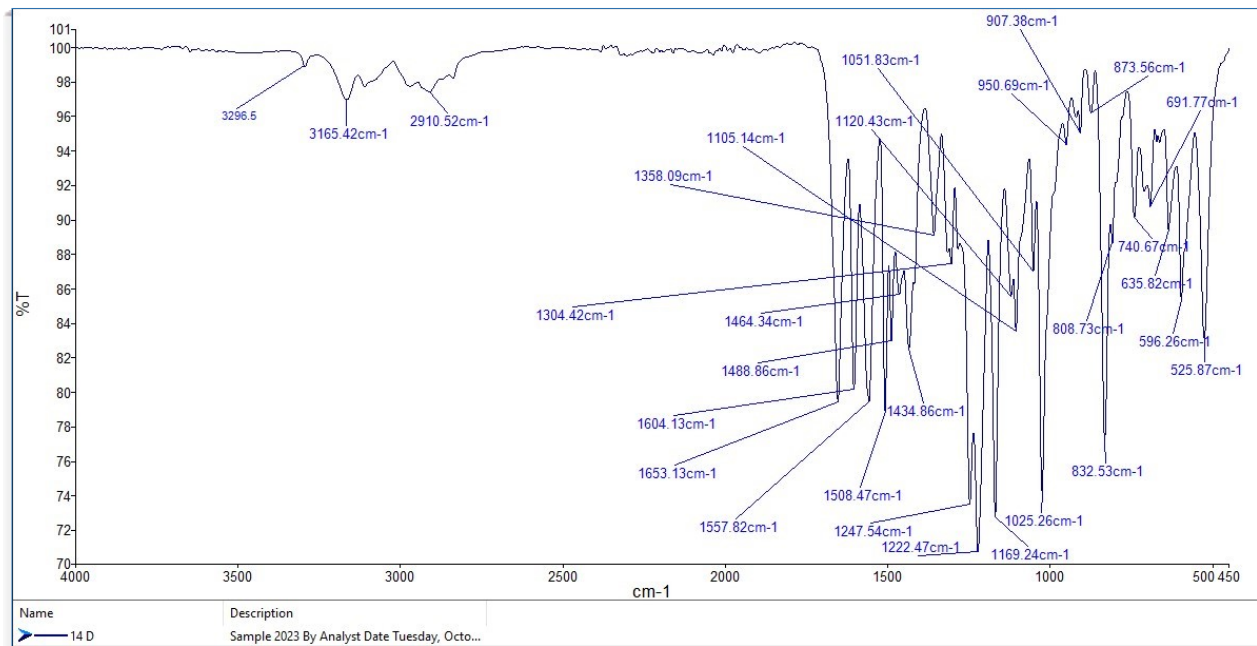


Fig. S54. IR spectrum of **15b**

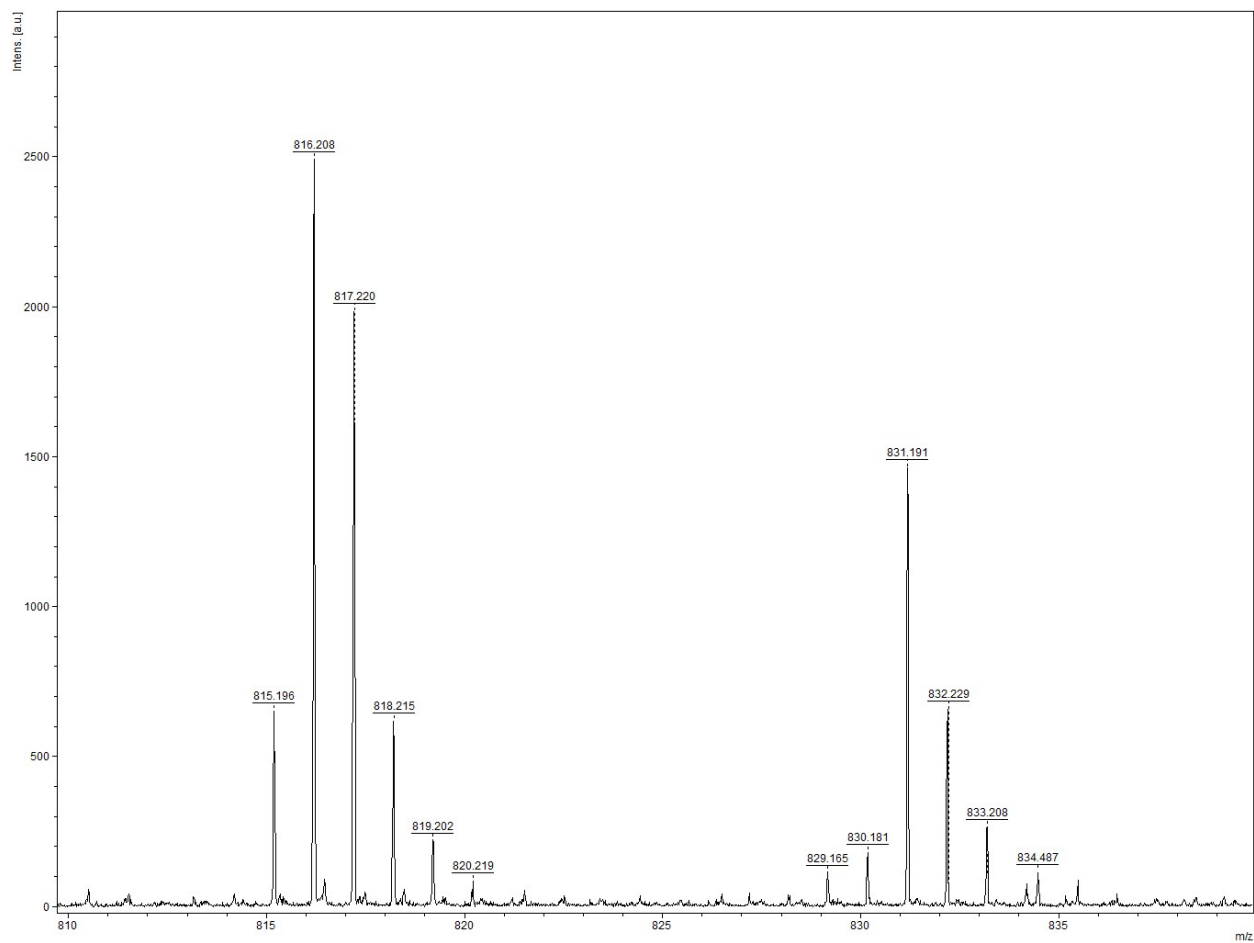


Fig. S55. Mass spectrum of **15b**

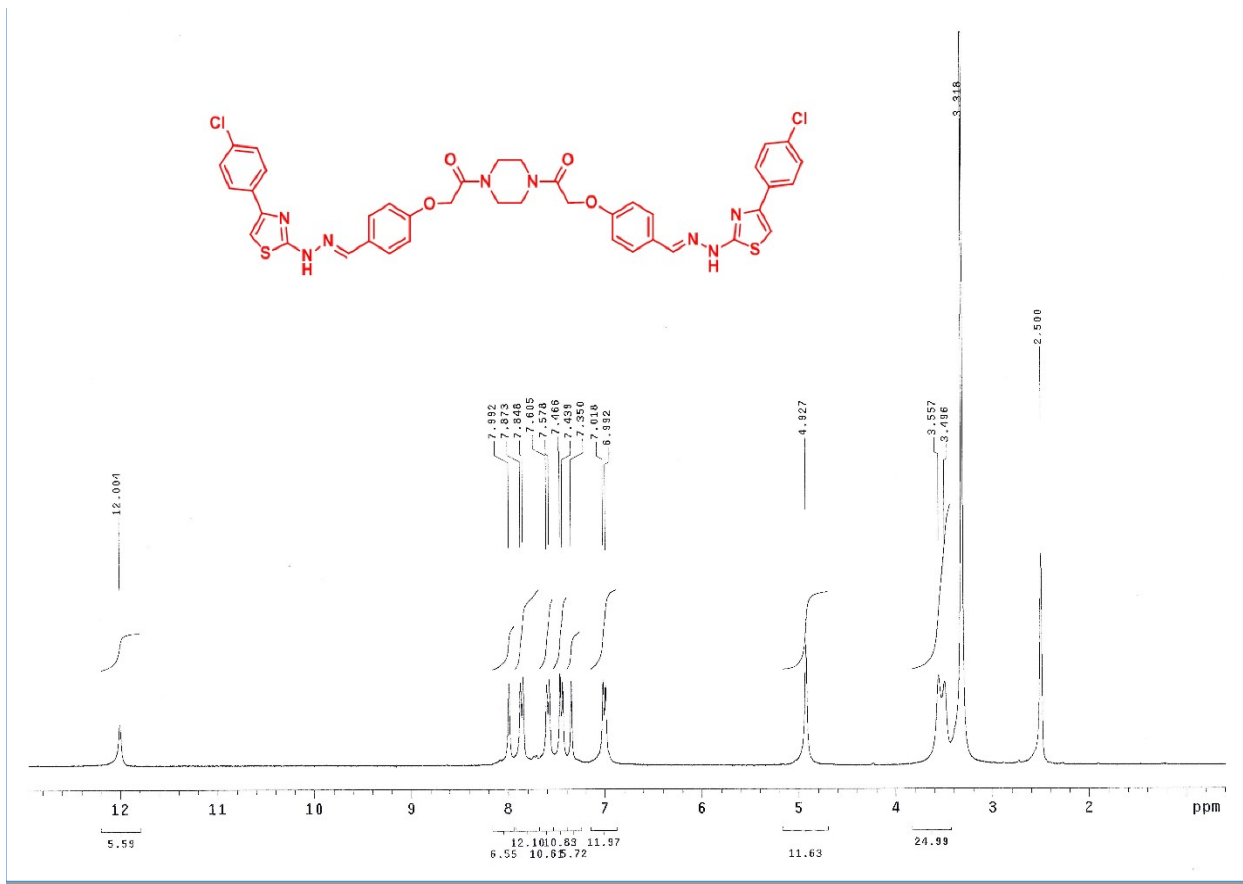


Fig. S56. ¹H NMR spectrum of 15c

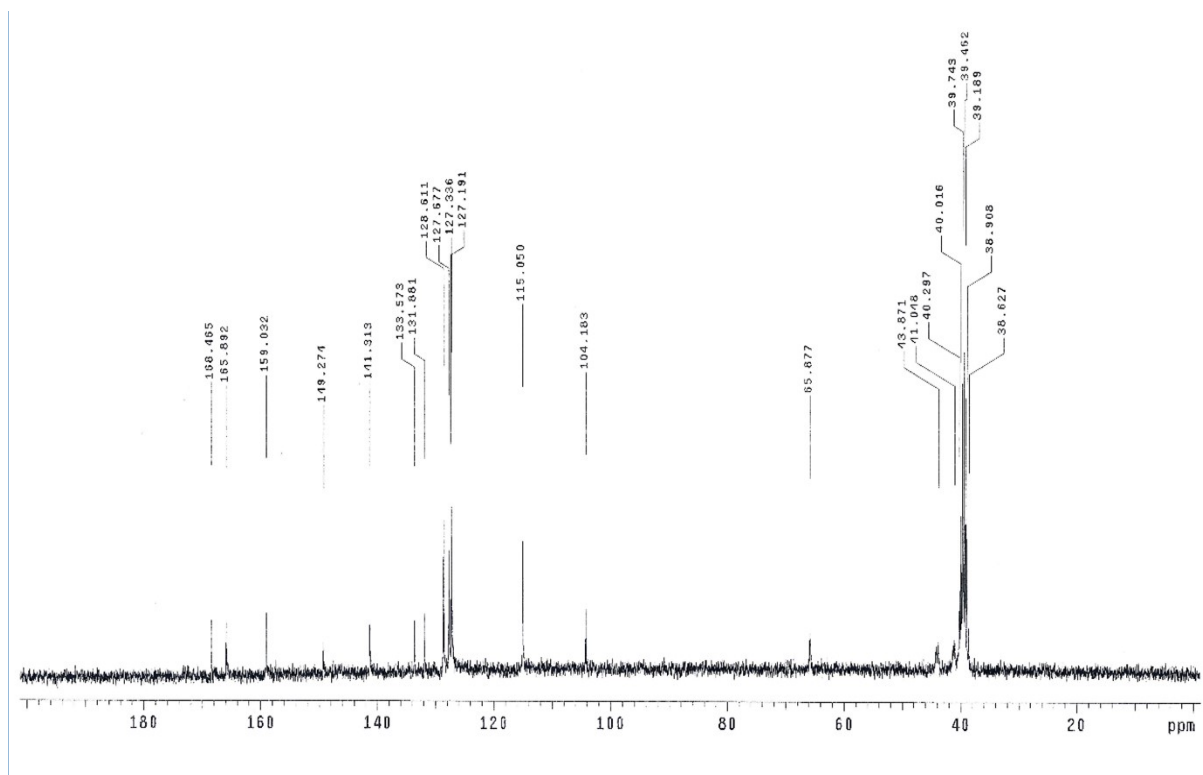


Fig. S57. ¹³C NMR spectrum of 15c

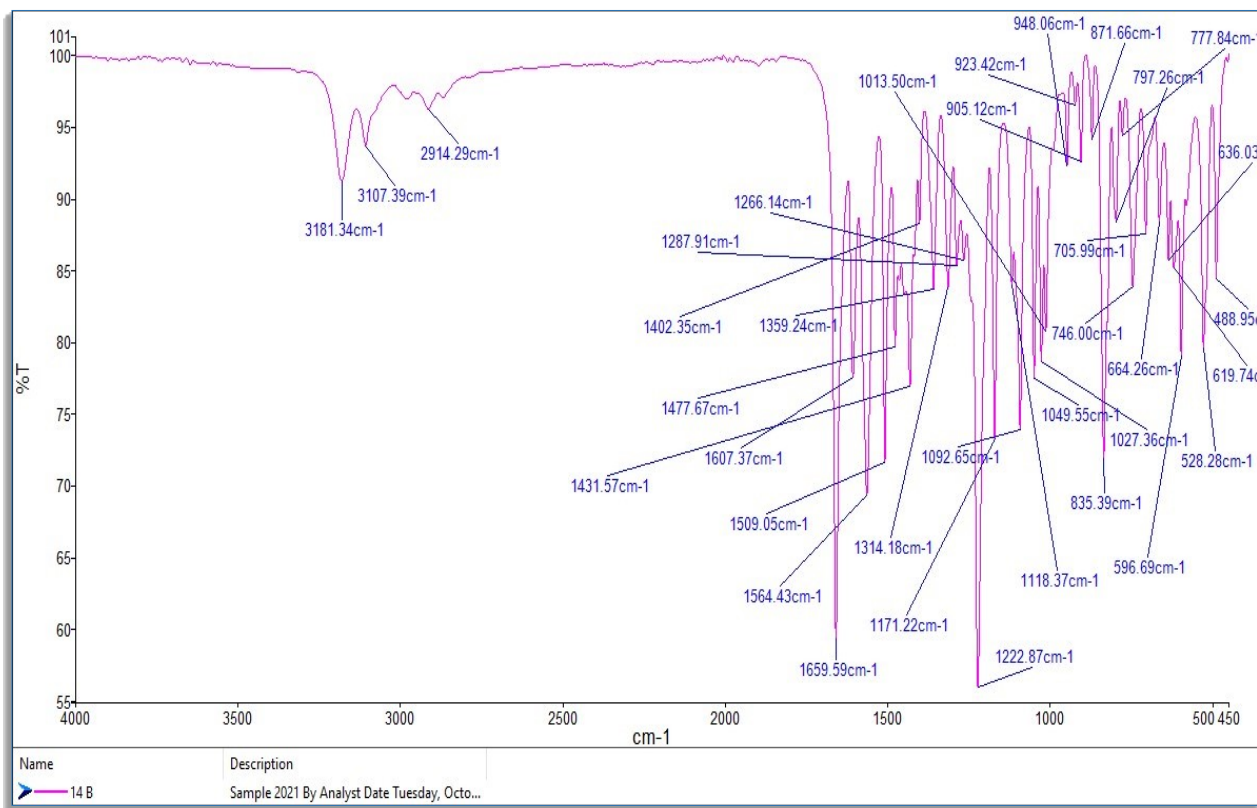


Fig. S58. IR spectrum of **15c**

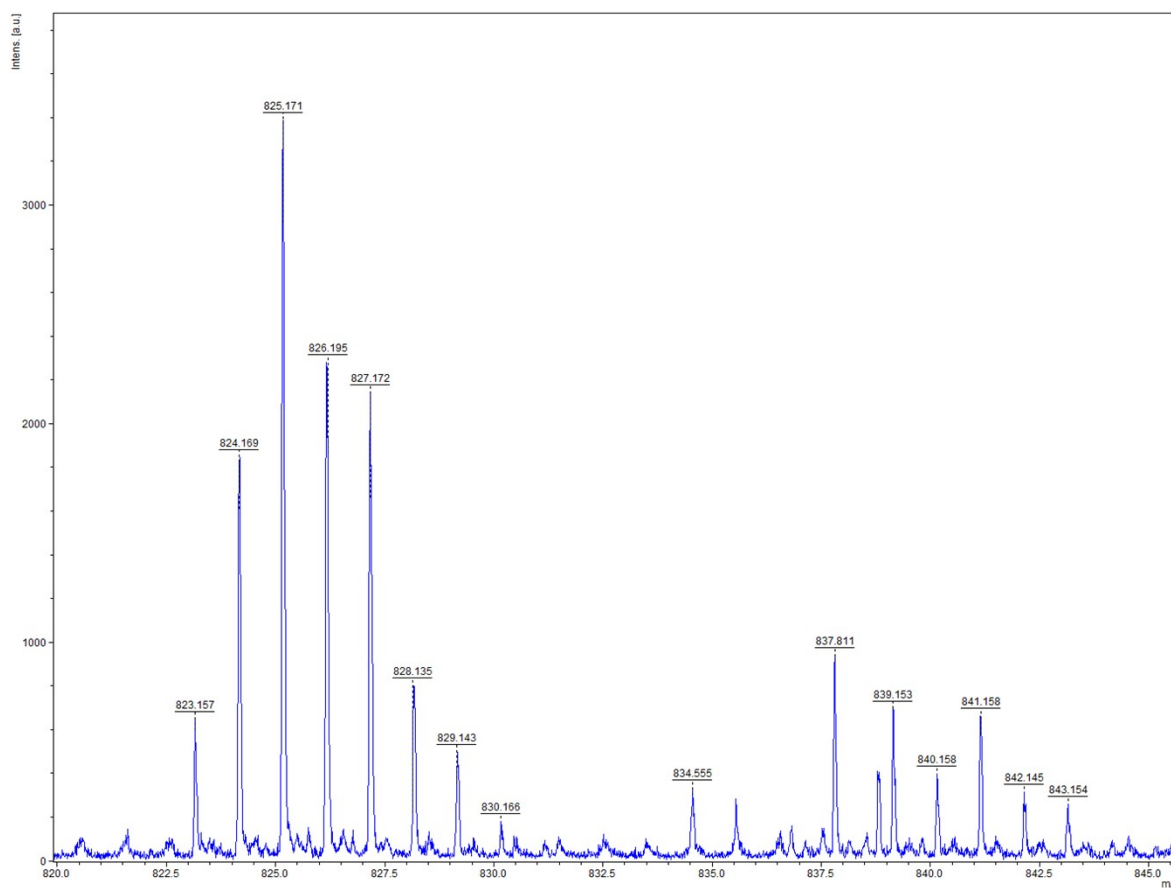


Fig. S59. Mass spectrum of **15c**

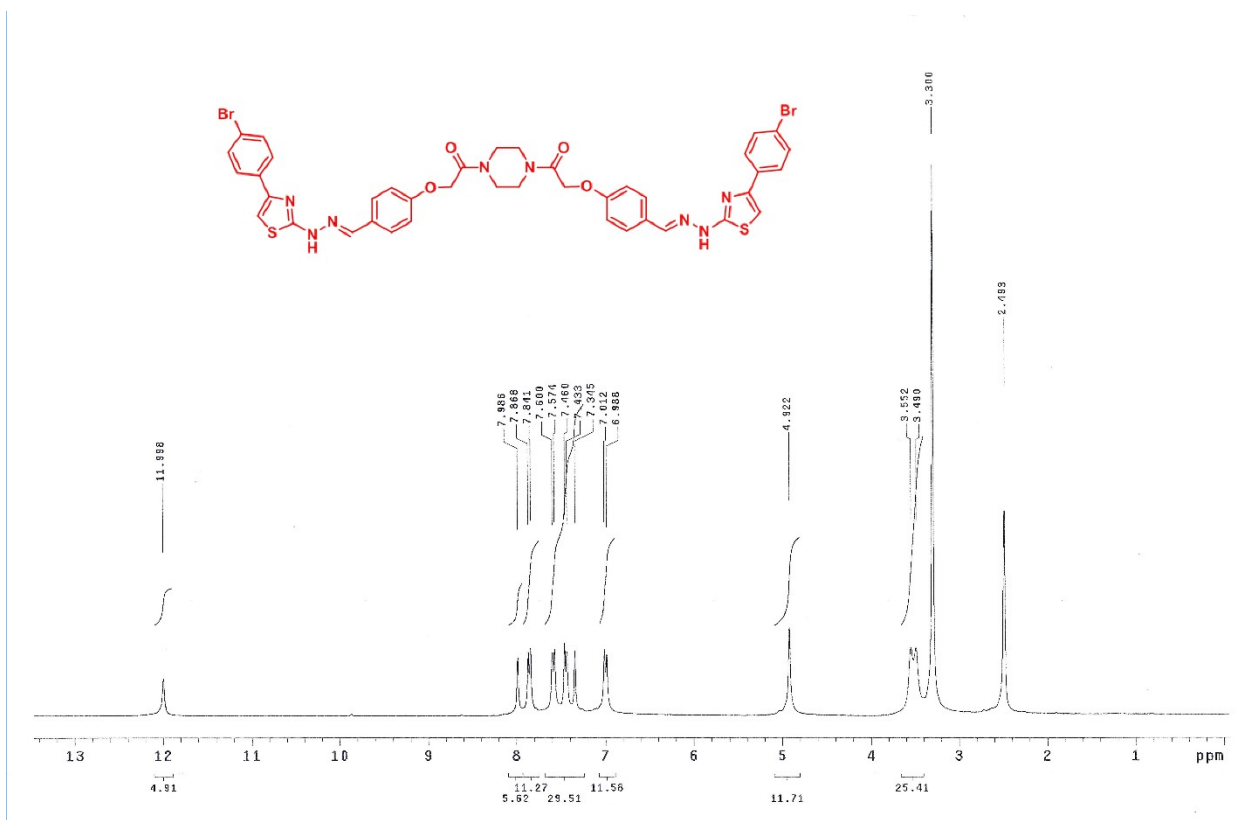
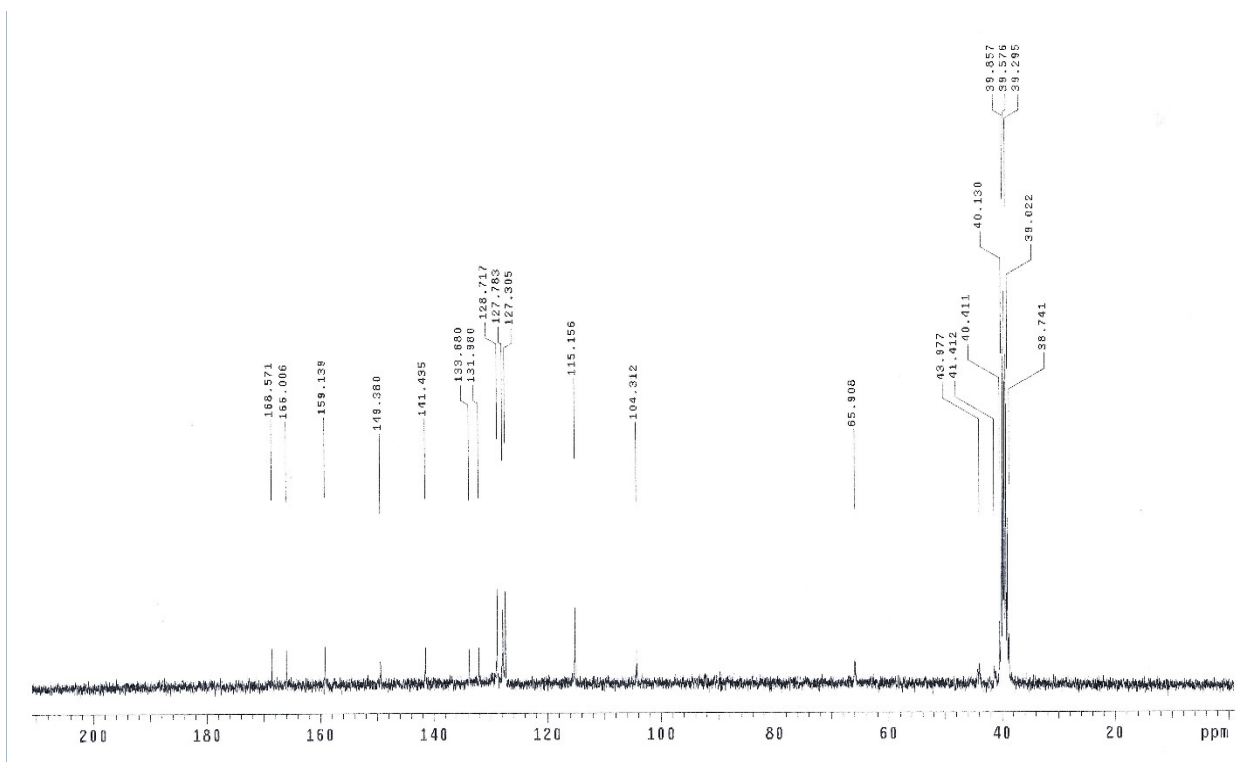


Fig. S60. ¹H NMR spectrum of 15d



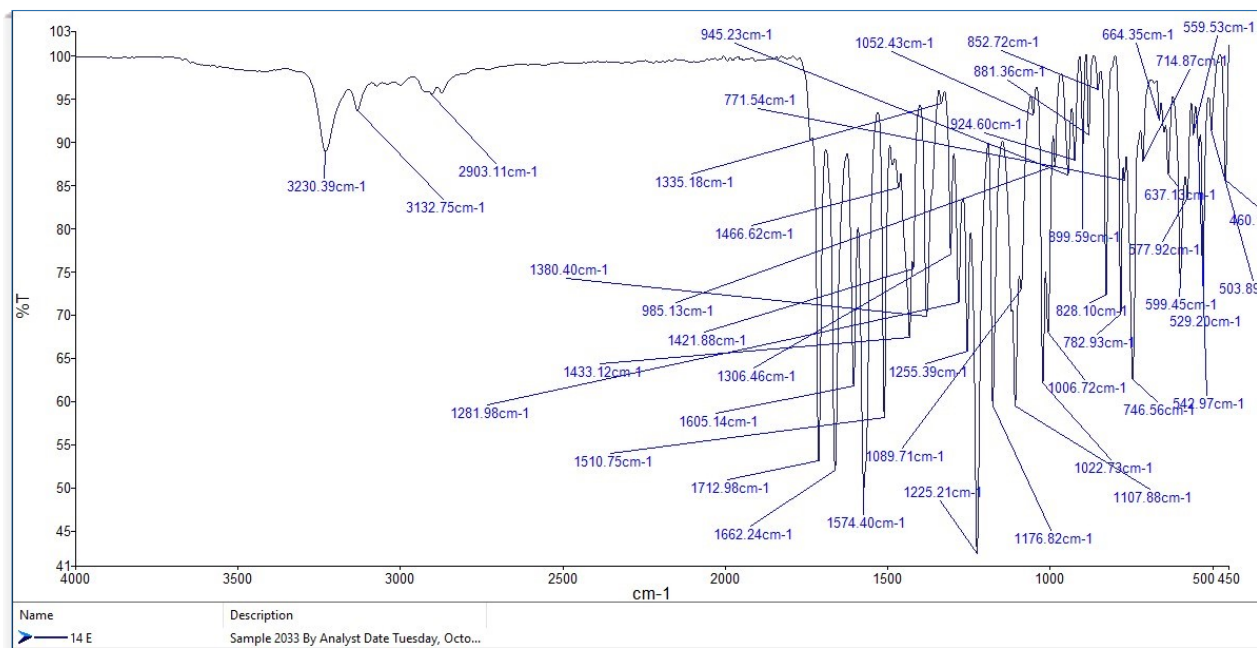


Fig. S64. IR spectrum of **15e**

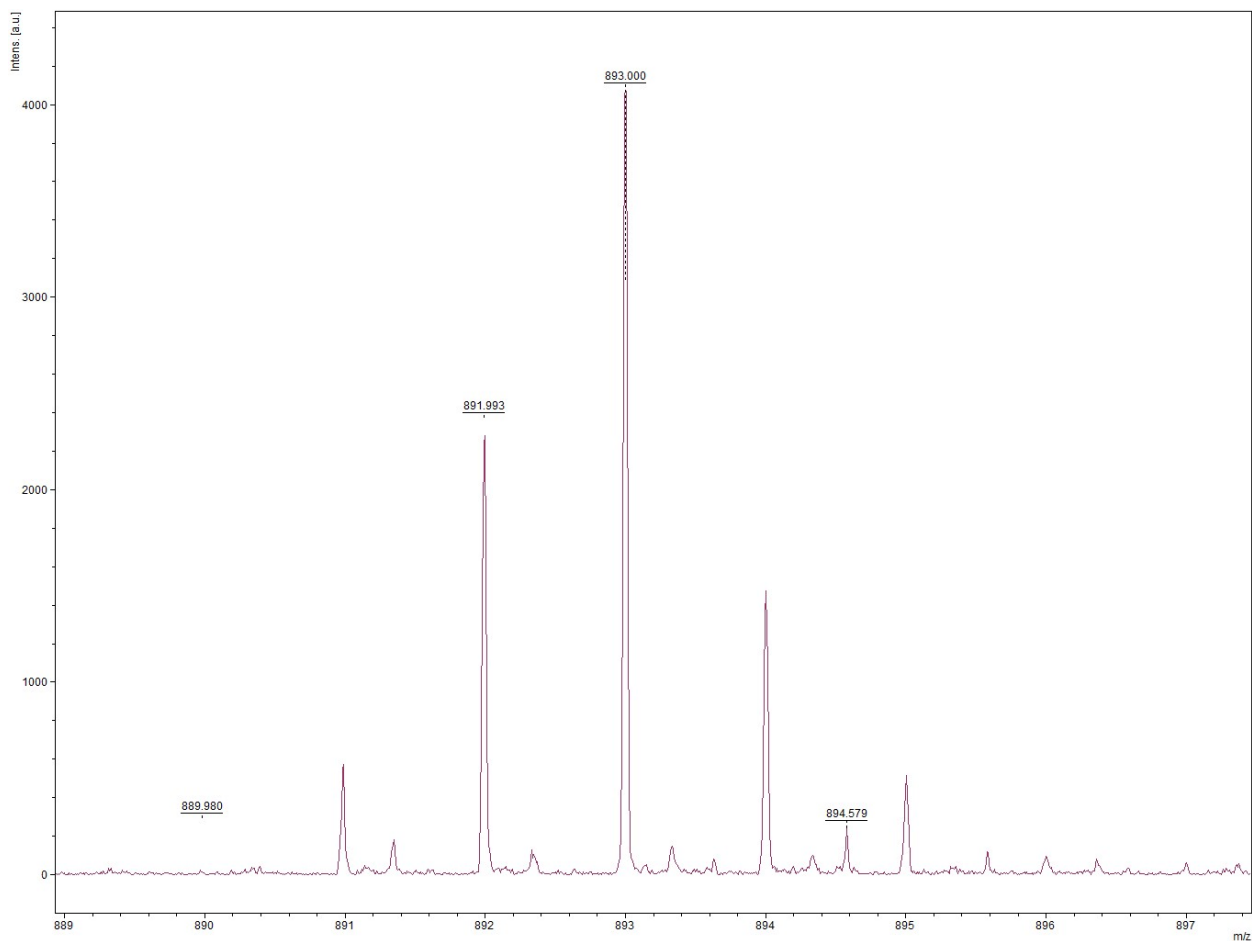


Fig. S65. Mass spectrum of **15e**

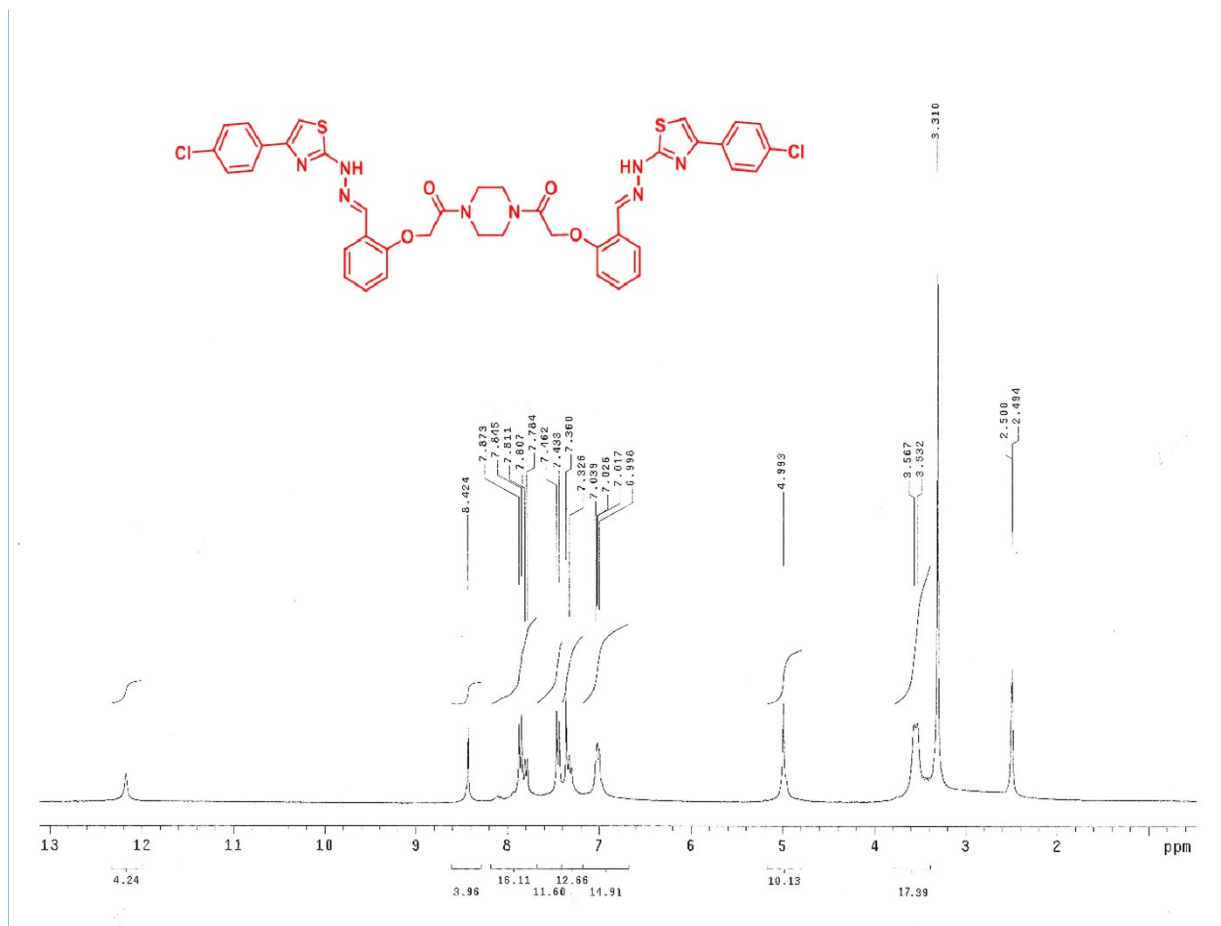


Fig. S66. ¹H NMR spectrum of 15f

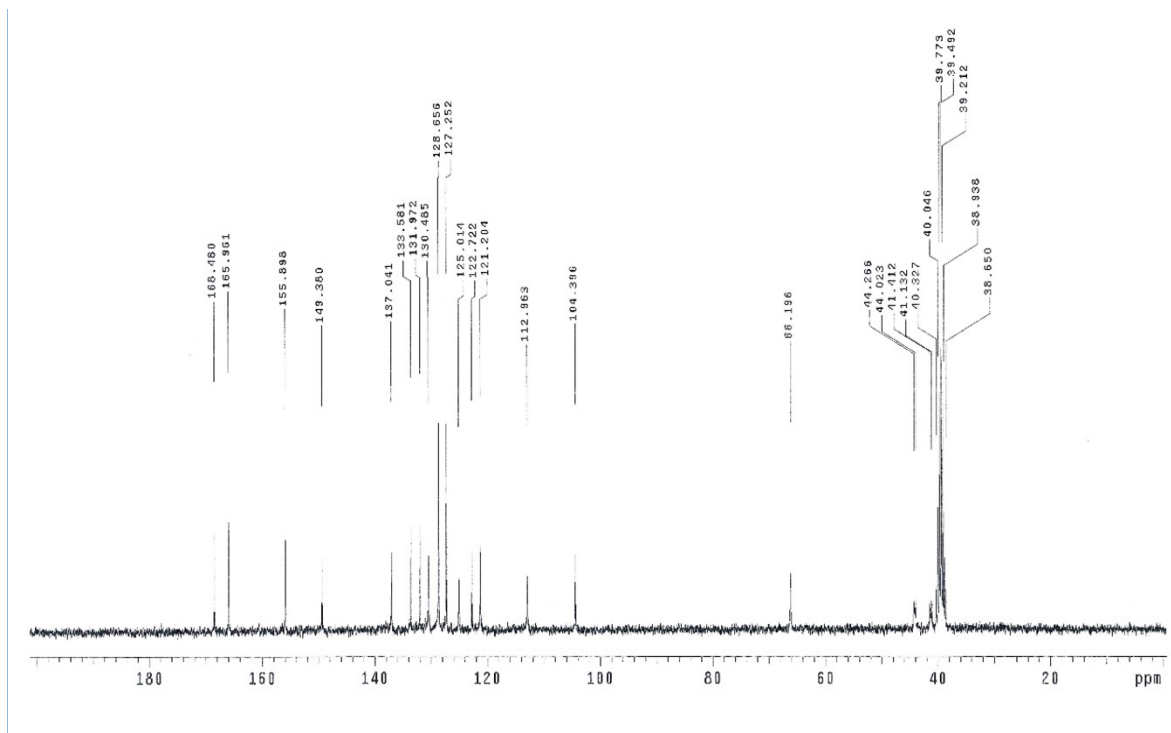


Fig. S67. ¹³C NMR spectrum of 15f

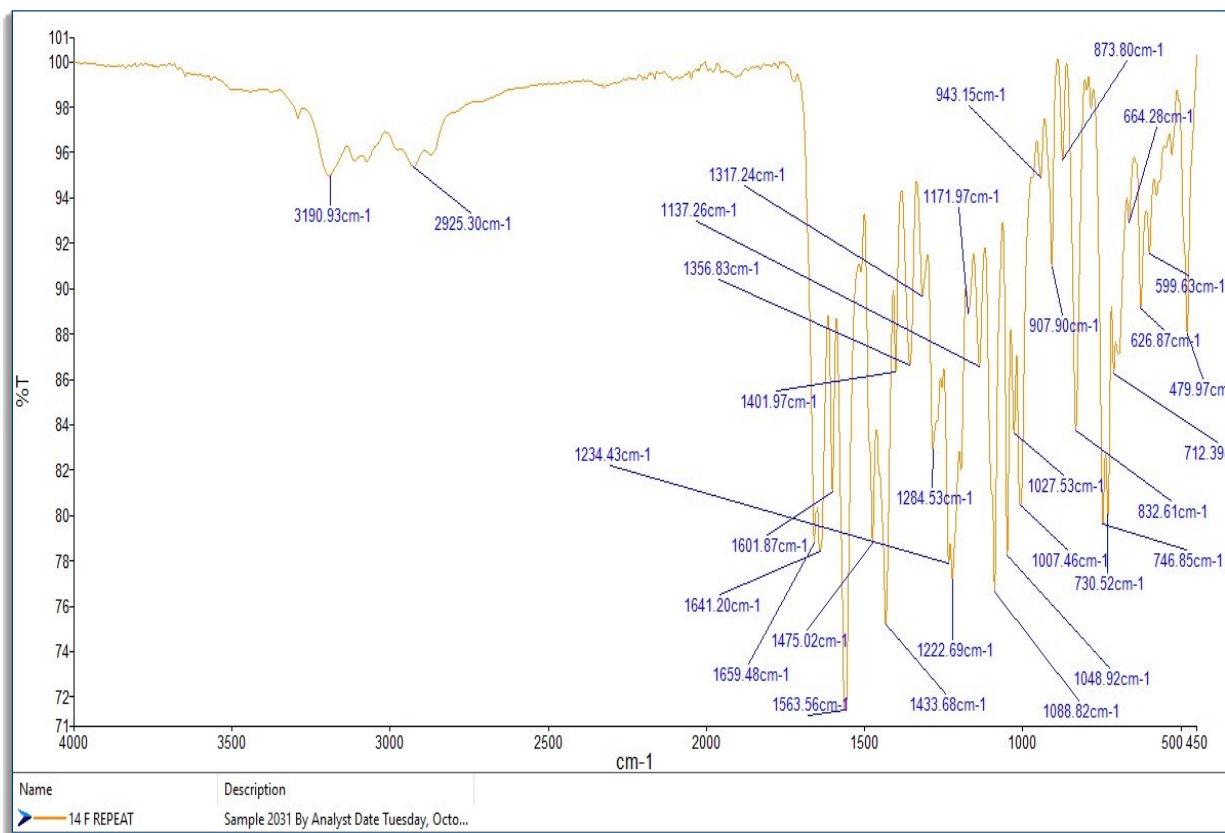


Fig. S68. IR spectrum of **15f**

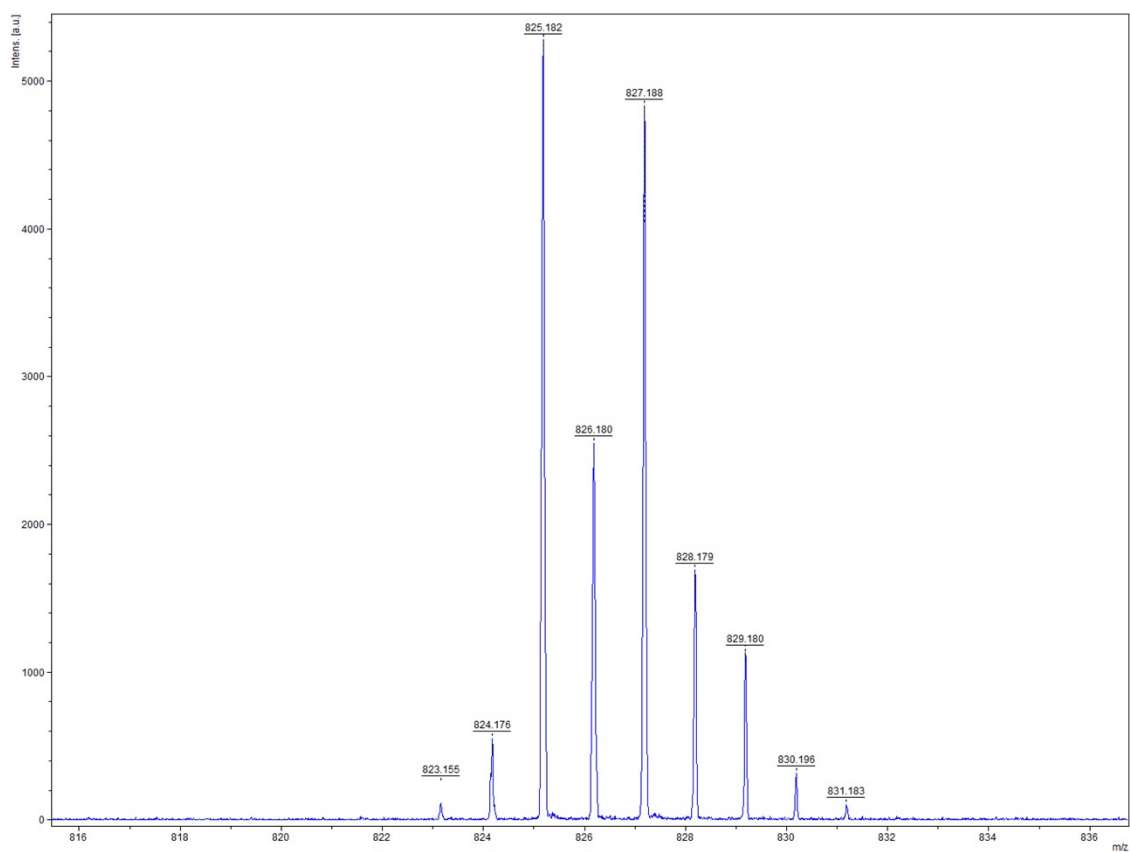


Fig. S69. Mass spectrum of **15f**

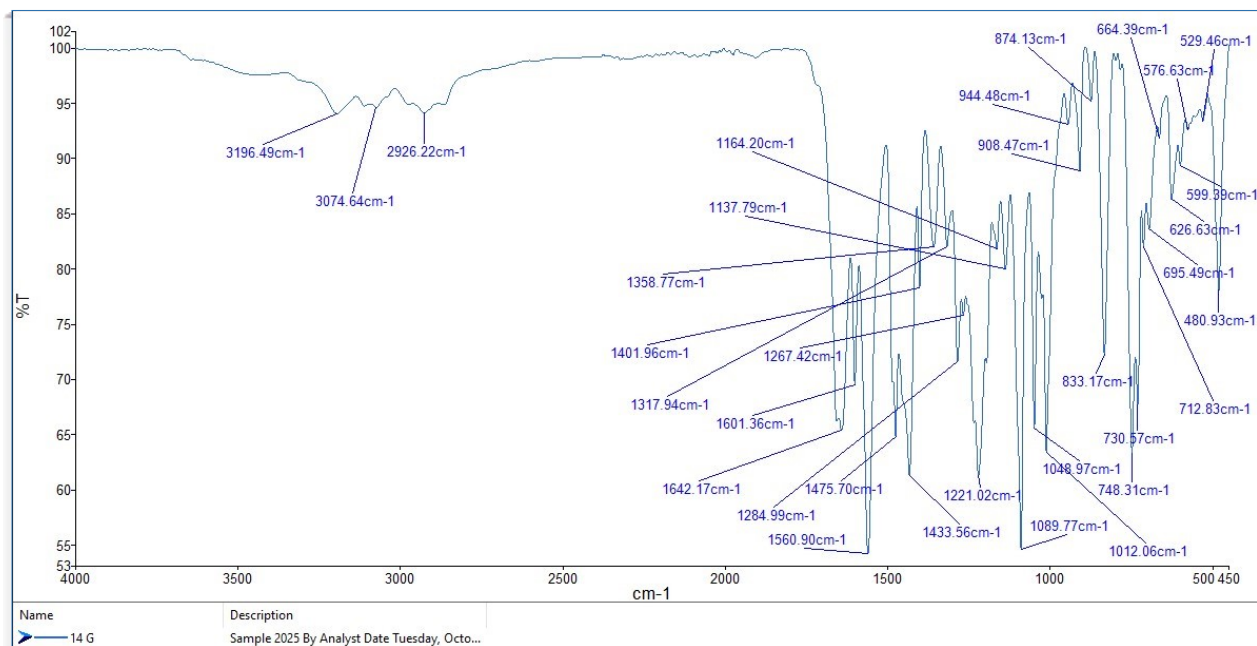


Fig. S72. IR spectrum of 15g

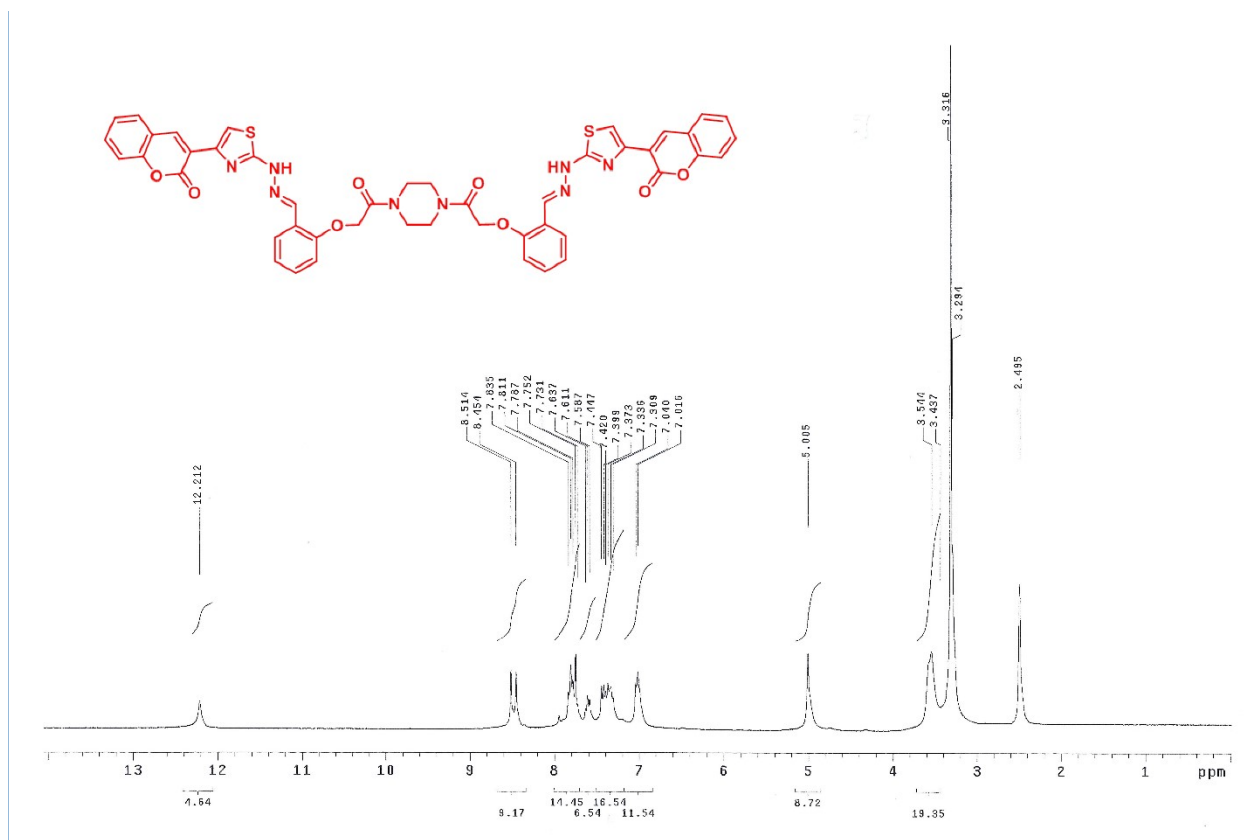


Fig. S73. ¹H NMR spectrum of 15h

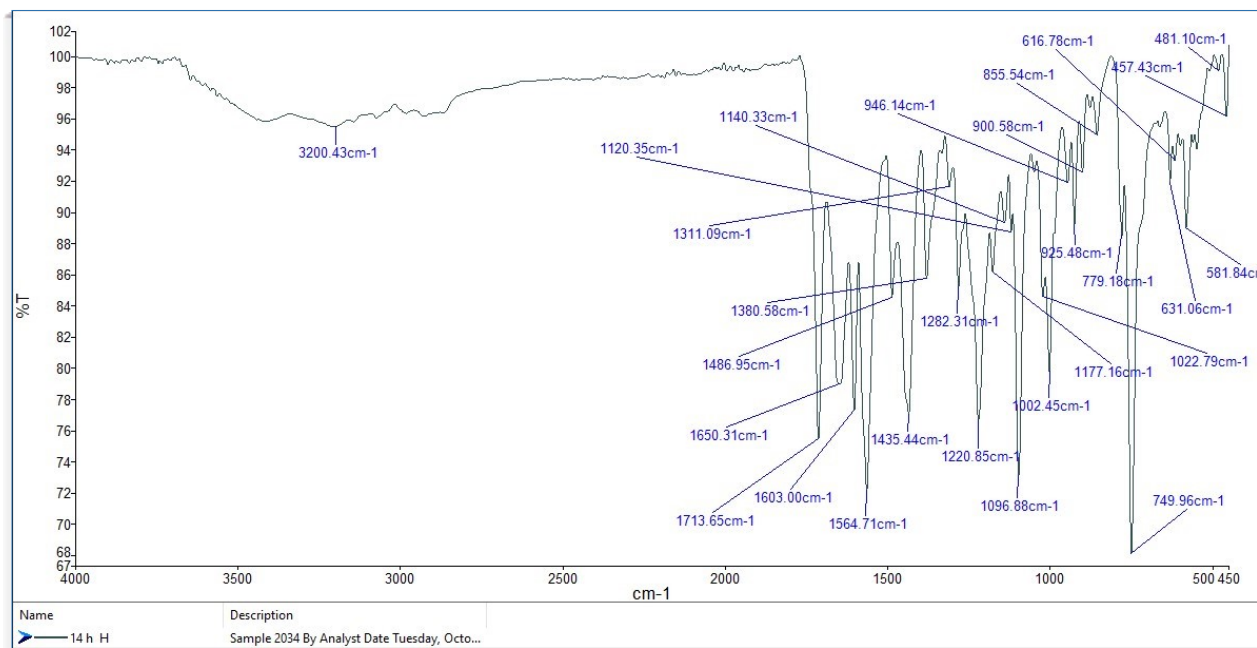


Fig. S74. IR spectrum of **15h**

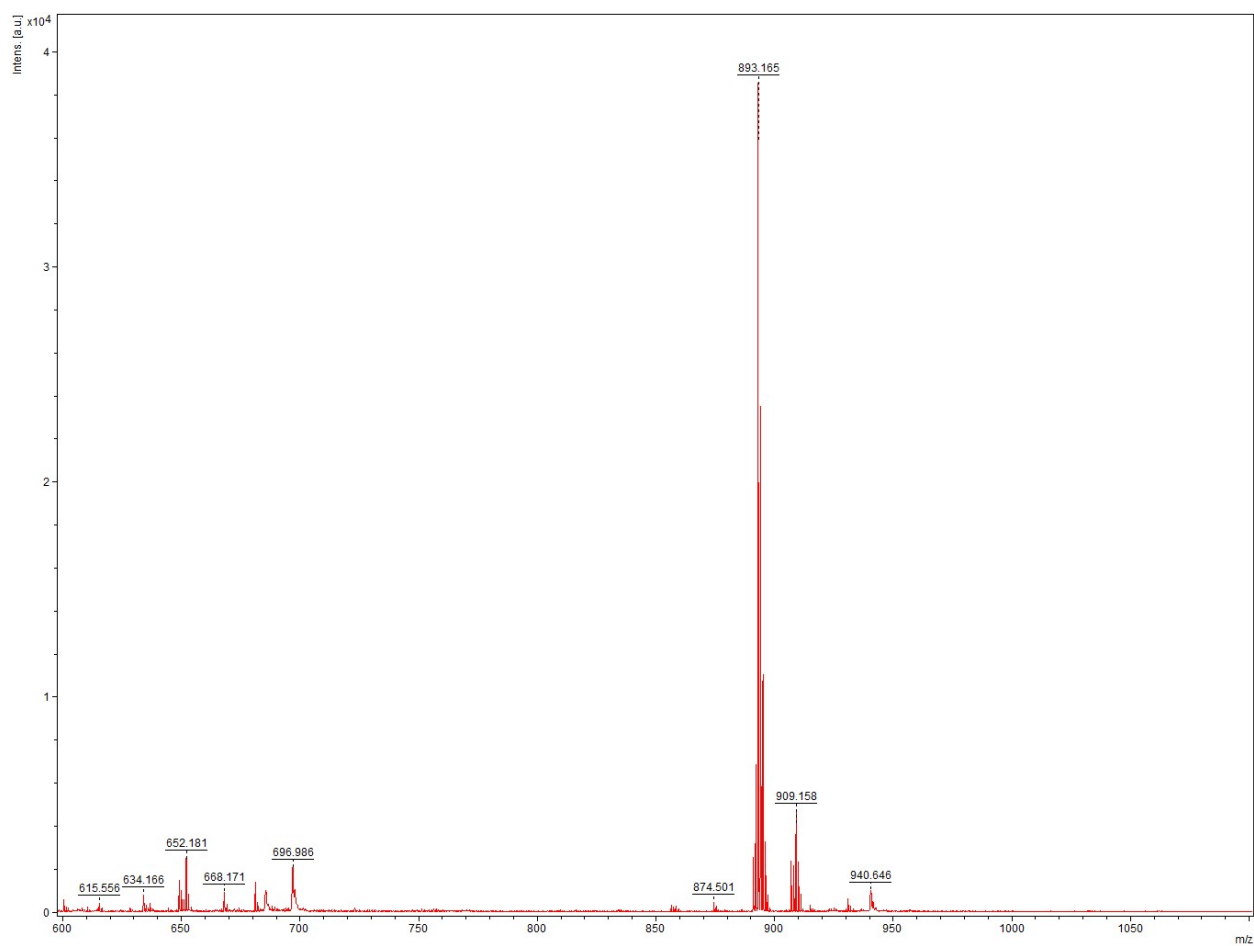


Fig. S75. Mass spectrum of **15h**