SUPPORTING INFORMATIONS

Microstructural investigation and magnetic studies on sonochemically synthesized Ni substituted copper zinc ferrite nanoparticles for Heterogeneous Green Catalytic Click Chemistry and Dye Degradation

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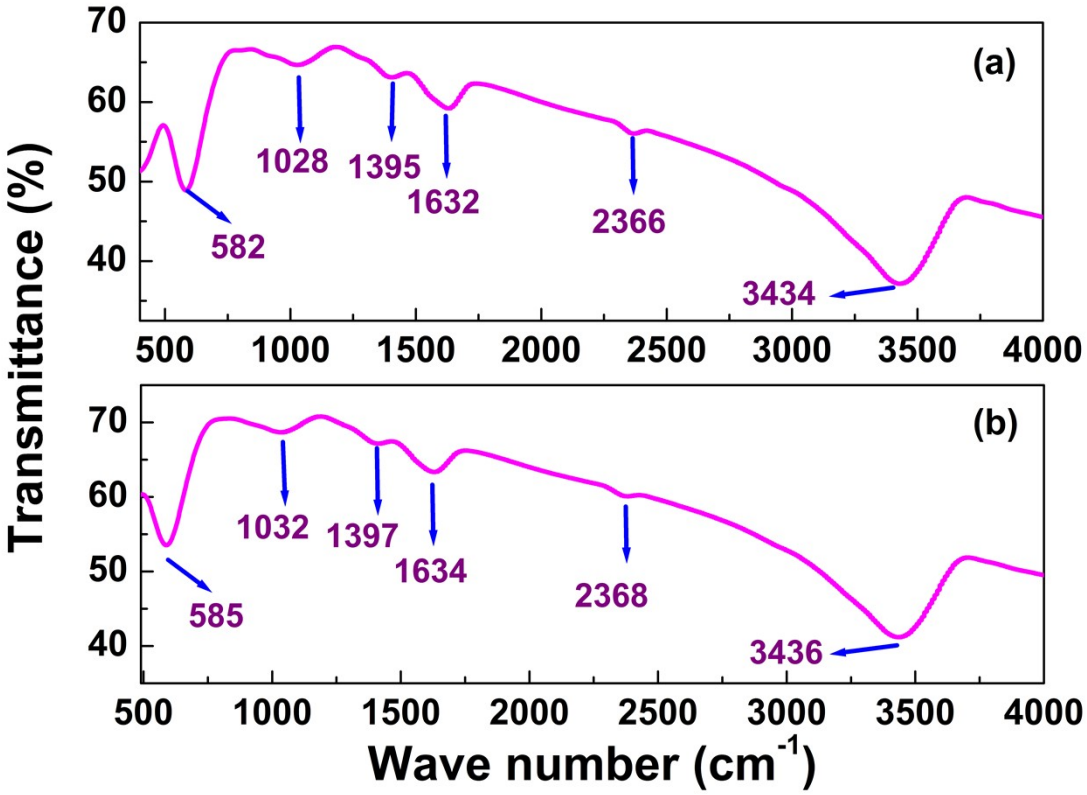
Table S1: Structural and microstructural parameters along with metal-oxygen (M-O) bond lengths of the sample obtained from Rietveld analysis of PXRD pattern of the sample by MAUD software.

Parameters	Values
Formula Weight	238.143
Crystal System	cubic
Space group	Fd-3m
Lattice parameter (Å)	8.35
Volume ($Å^3$)	582.20
Metal-Oxygen bond length (Å)	1.807(A-site)
	2.08(B-site)
Metal-Oxygen bond angle	109.47° (A-site)
	90.1° (B-site)
R_{wp} (%)	1.620
R_{exp} (%)	1.0766
GOF (sig)	1.505

Table S2: Fractional coordinates and occupancy of different ions obtained from the Rietveld refinement by MAUD software.

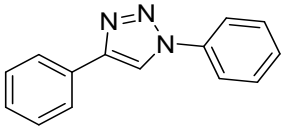
Ions	x	**y**	z	Occupancy (± 0.002)
Zn (A)	0	0	0	0.2
Fe (A)	0	0	0	0.8
Cu (B)	0.625	0.625	0.625	0.25
Ni(B)	0.625	0.625	0.625	0.15
Fe (B)	0.625	0.625	0.625	0.6
O	0.375	0.375	0.375	1.00

Stability of the catalyst: To determine the stability of the catalyst FTIR after three run has been performed and compared to fresh. It shows that the catalyst is fairly stable (please see supporting information). The FTIR spectra of the fresh catalyst (Fig. a) and the used catalyst (Fig. b) exhibit the same characteristic absorption pattern. Only minor shifts in wave numbers and slight variations in transmittance are observed in Fig. b compared to Fig. a. These small changes indicate that no significant structural alteration has occurred during the reaction. Therefore, the catalyst can be considered **structurally stable** under the reaction conditions.

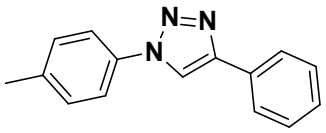


FTIR spectra of the fresh catalyst (Fig. a) and the used catalyst (Fig. b)

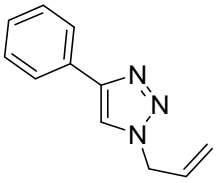
Analytical data of the synthesized organic compounds:



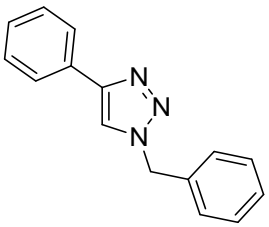
1,4-diphenyl-1H-1,2,3-triazole (P_1): white solid, ^{1}H NMR (d_6-DMSO, 400 MHz) δ 7.35 (t, J= 6 Hz, 1H), 7.37-7.54 (m, 3 H), 7.64 (t, J = 7.5 Hz, 2H), 7.94-7.97 (m, 4H), 9.31 (s, 1H). ^{13}C NMR (CDCl3, 100 MHz) δ 117.6, 120.5, 125.8, 128.4, 128.8, 128.9, 129.7, 130.0, 137.0. 148.5. LC-MS Calcd. for C14H11N3 m/z 221.1, found (M+H) 222.1.



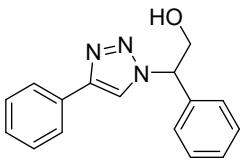
4-phenyl-1-(p-tolyl)-1H-1,2,3-triazole (P_2): ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 2.40 (s, 3H); 7.36-7.51 (m, 5H), 7.83 (d, J = 8.2 Hz, 2H), 7.94 (d, J = 7.6 Hz, 2H), 9.3 (s, 1H). ^{13}C NMR (CDCl3, 100 MHz) δ 21.1, 117.6, 120.6, 125.8, 128.3, 128.8, 130.2, 134.7, 138.8, 148.2. LC-MS Calcd. for $C_{15}H_{13}N_3$ m/z 235.1, found (M+H) 236.3.



1-Allyl-4-phenyl-1H-[1,2,3]triazole (P_3): ^{1}H NMR (400 MHz, d6-DMSO): δ: 4.90-5.08 (m, 2H), 5.22-5.32 (m, 2H), 6.07-6.15 (m, 1H), 7.31-7.35 (m, 1H), 7.43-7.53 (m, 2H), 7.86 (d, 2H, *J*=7.2), 8.55 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ= 51.7, 118.7, 121.2, 125.0, 127.7, 128.7, 131.0, 130.6, 132.5, 146.35. Anal. ($C_{11}H_{11}N_3$) calcd, C: 71.33; H: 5.99; N: 22.69; found, C: 71.35; H: 6.04; N: 22.72.



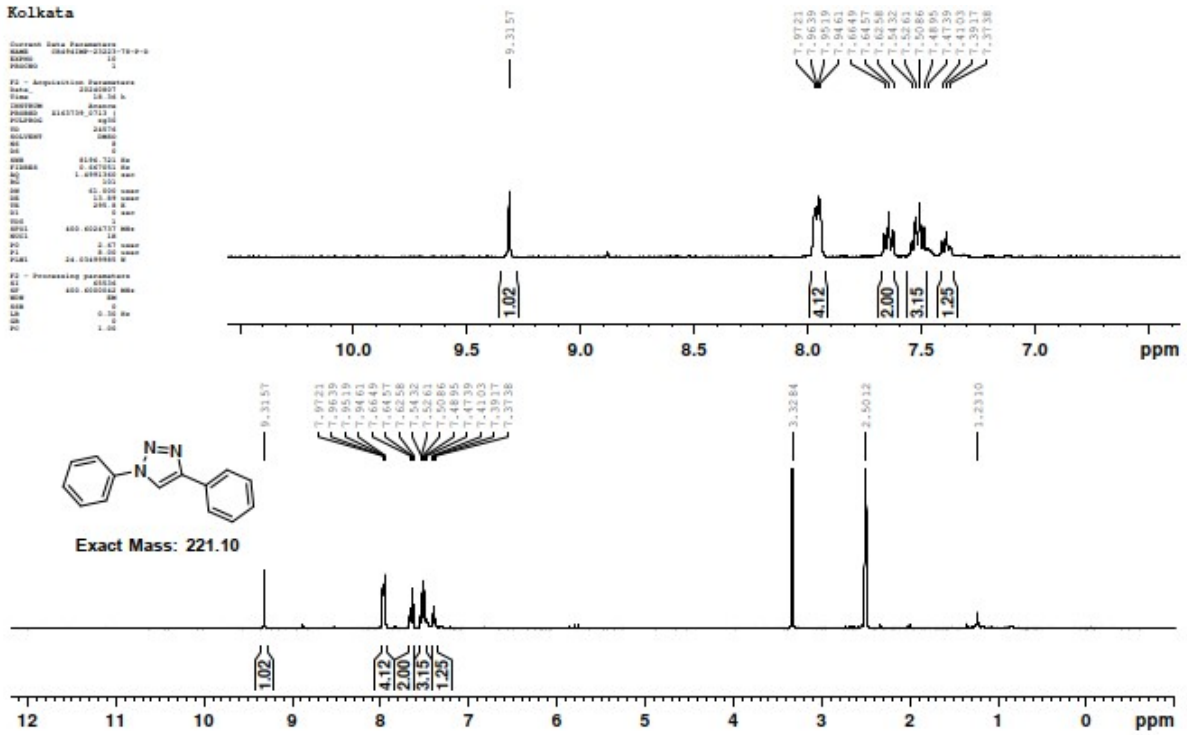
1-Benzyl-4-phenyl-1H-1,2,3-triazole (P_4): ^{1}H NMR (600 MHz, $CDCl_3$): *δ:* 5.59 (s, 2H), 7.32–7.345 (m, 3H), 7.38–7.434 (m, 5H), 7.68 (s, 1H), 7.80–7.82 (m, 2H). ^{13}C NMR (150 MHz, $CDCl_3$): *δ*: 147.79, 134.23, 130.07, 128.71, 128.36, 127.62, 127.61, 125.25, 119.04, 53.79. Anal. ($C_{15}H_{13}N_3$) calcd, C: 76.57; H: 5.57; N: 17.86; found, C: 76.61; H: 5.60; N: 17.89.



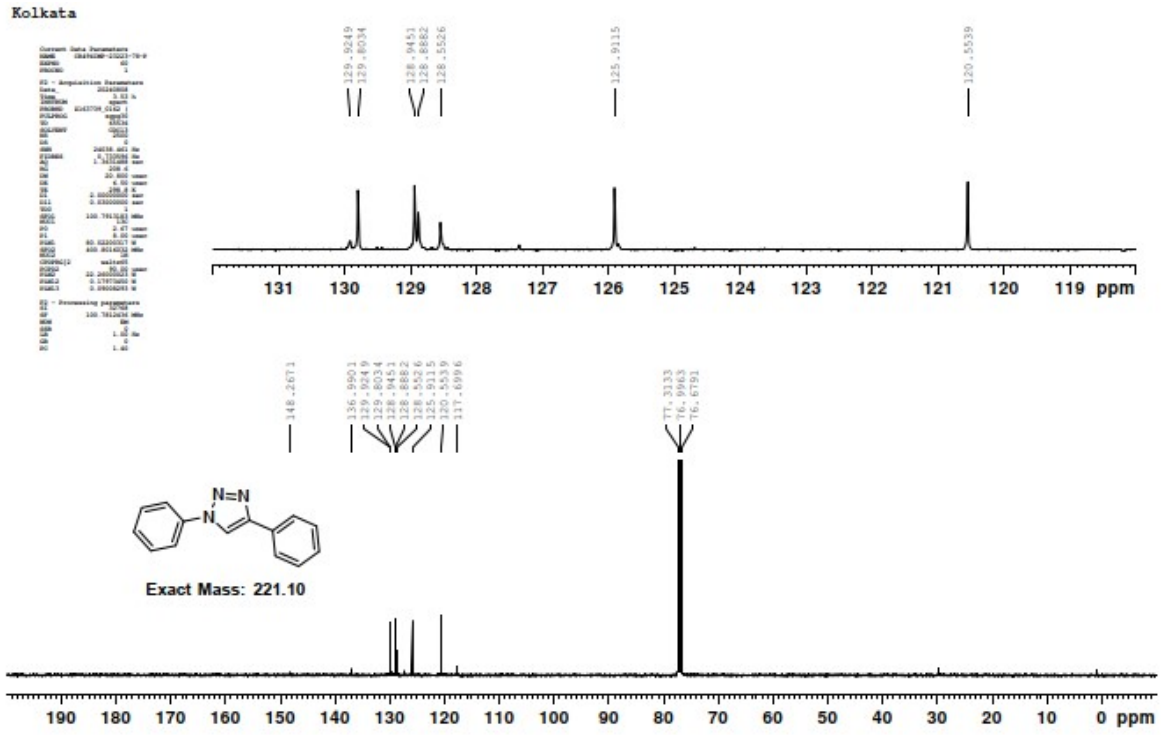
2-phenyl-2-(4-phenyl-1H-1,2,3-triazol-1-yl)ethan-1-ol (P5):

White solid, ^{1}H NMR (400 MHz, DMSO) δ 3.99 – 4.09 (m, 1H), 4.27 – 4.38 (m, 1H), 5.36 (t, *J* = 5.5 Hz, 1H), 5.79 – 5.87 (m, 1H), 7.29 – 7.50 (m, 8H), 7.87 (d, *J* = 7.7 Hz, 2H), 8.82 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 63.06, 66.33, 120.81, 125.0, 127.03, 127.71, 128.17, 128.60, 130.74, 137.22, 146.09. LC-MS Calcd. for C16H15N3O m/z 265.12, found (M+H) 266.2. LC-MS Calcd. for C16H15N3O m/z 265.12, found (M+H) 266.2.

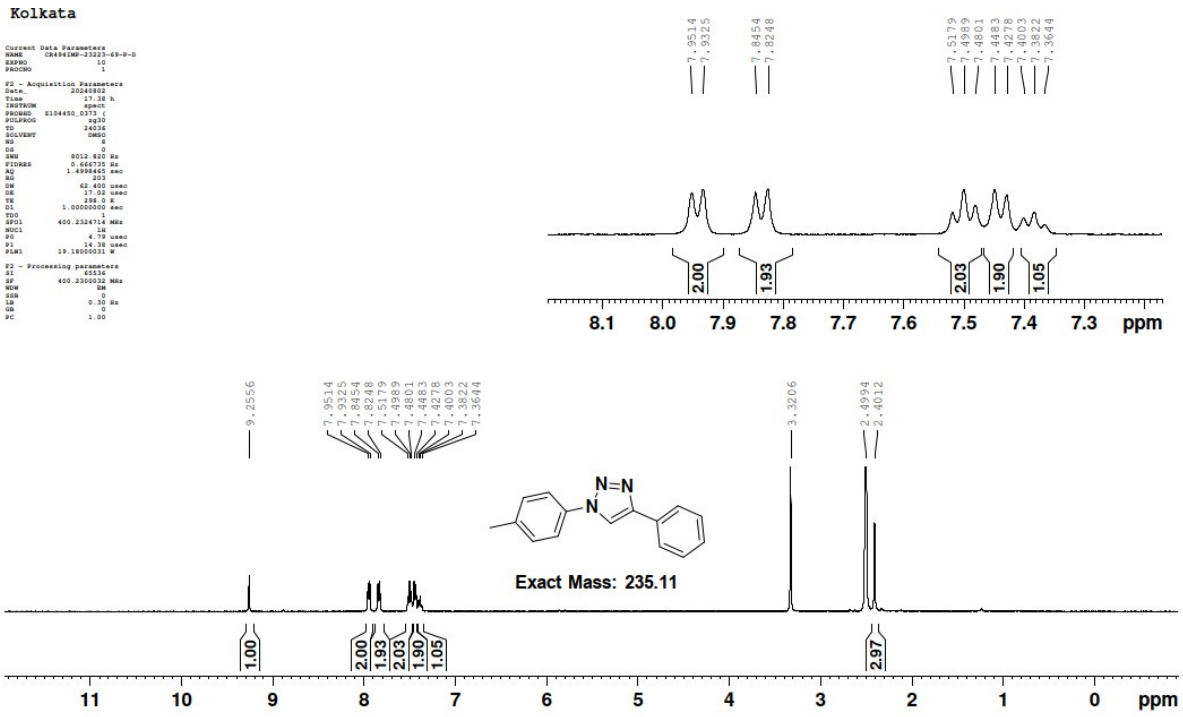
^{1}H NMR Spectra of the Compound *1,4-diphenyl-1H-1,2,3-triazole* (P_1):



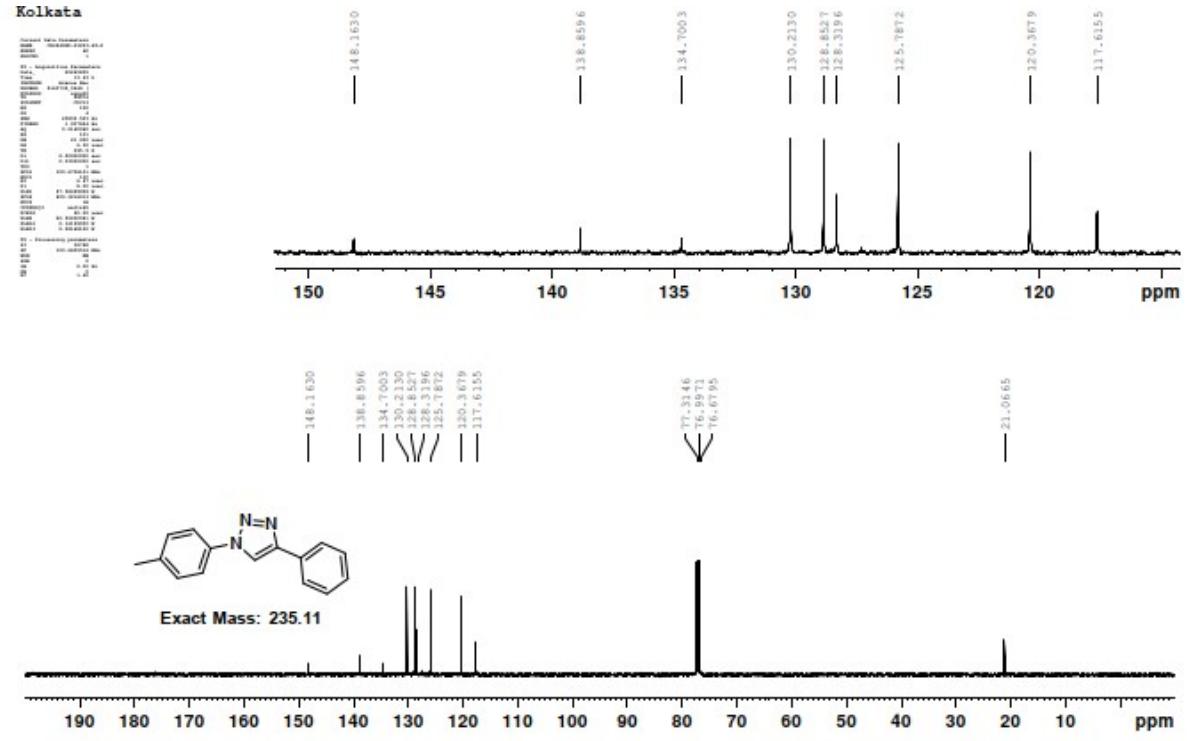
^{13}C NMR Spectrum of the Compound *1,4-diphenyl-1H-1,2,3-triazole (*P_1) :



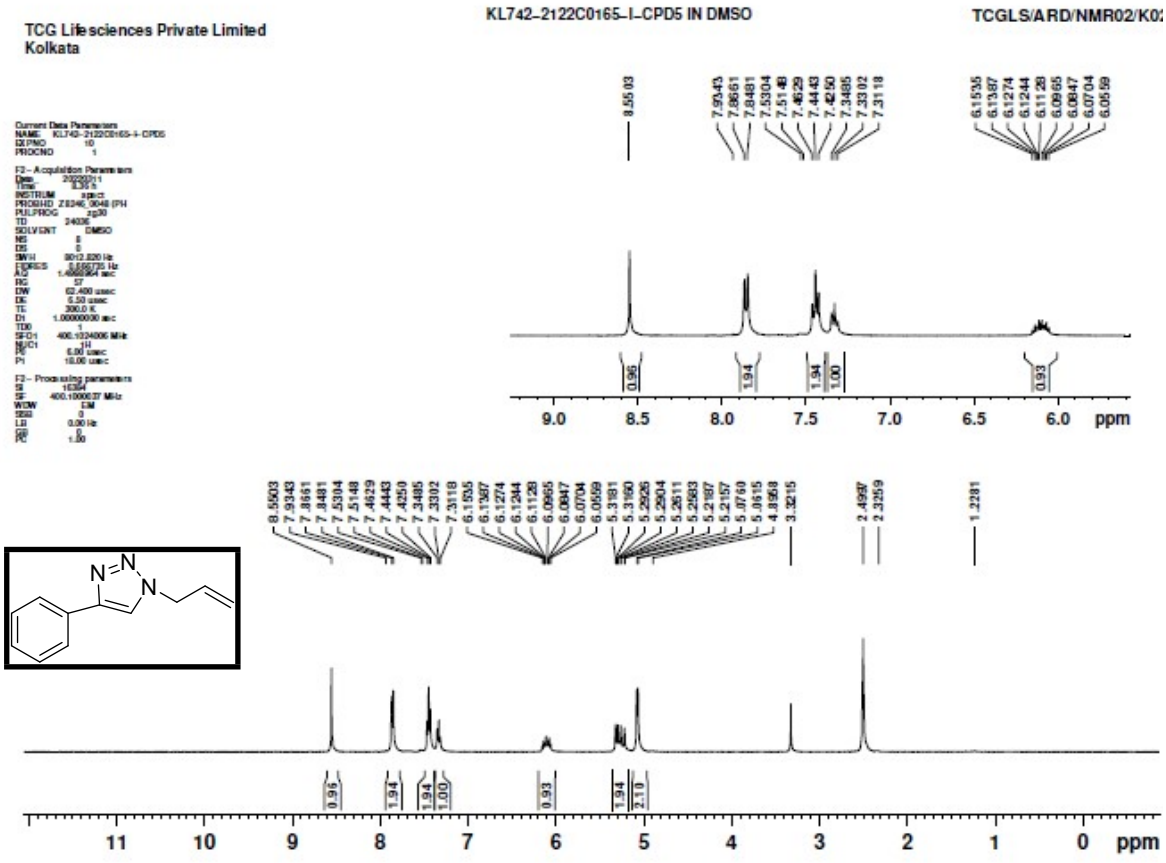
^{1}H NMR Spectra of Compound P_2:



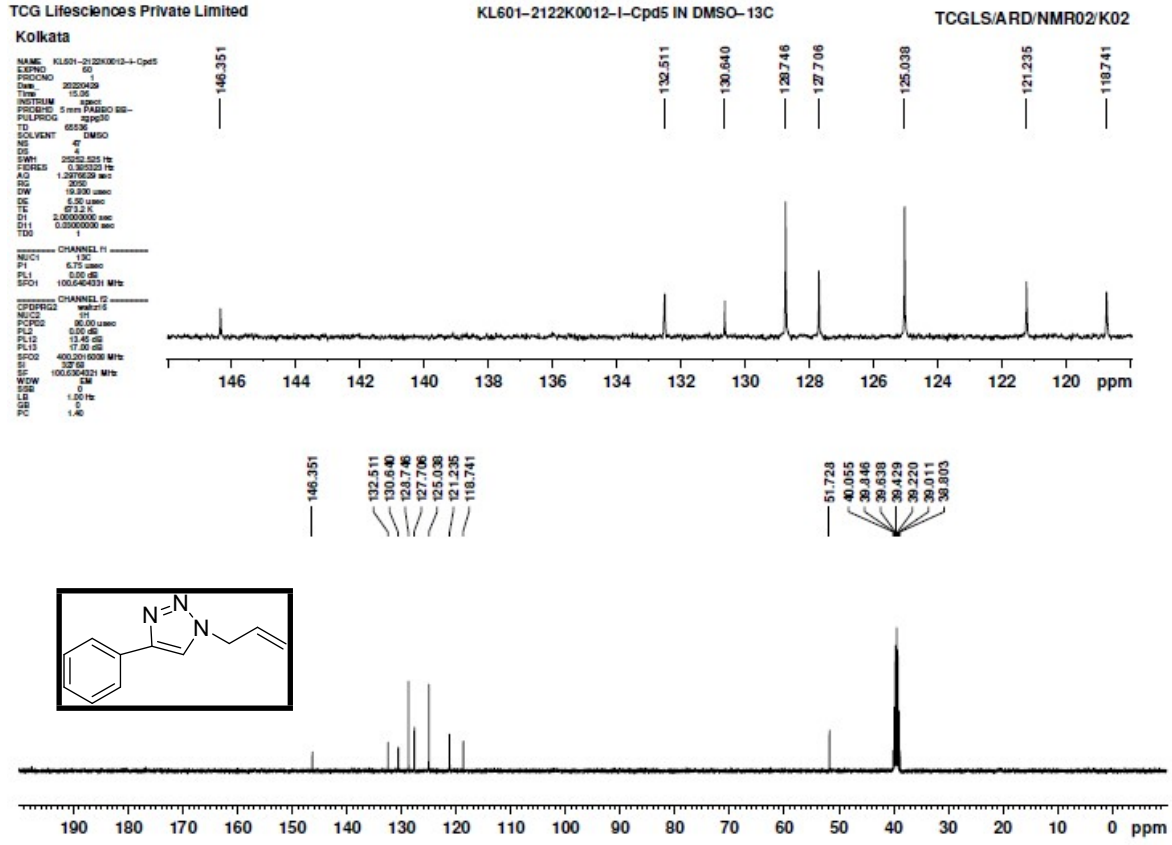
^{13}C NMR Spectra of Comp P_2:



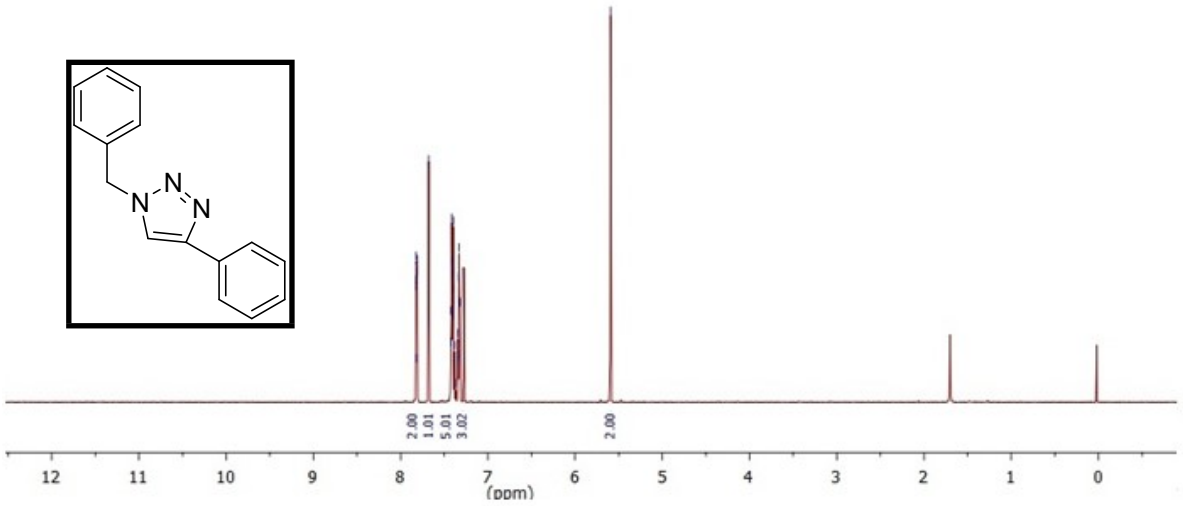
^{1}H NMR spectra of the compound **P_3:**



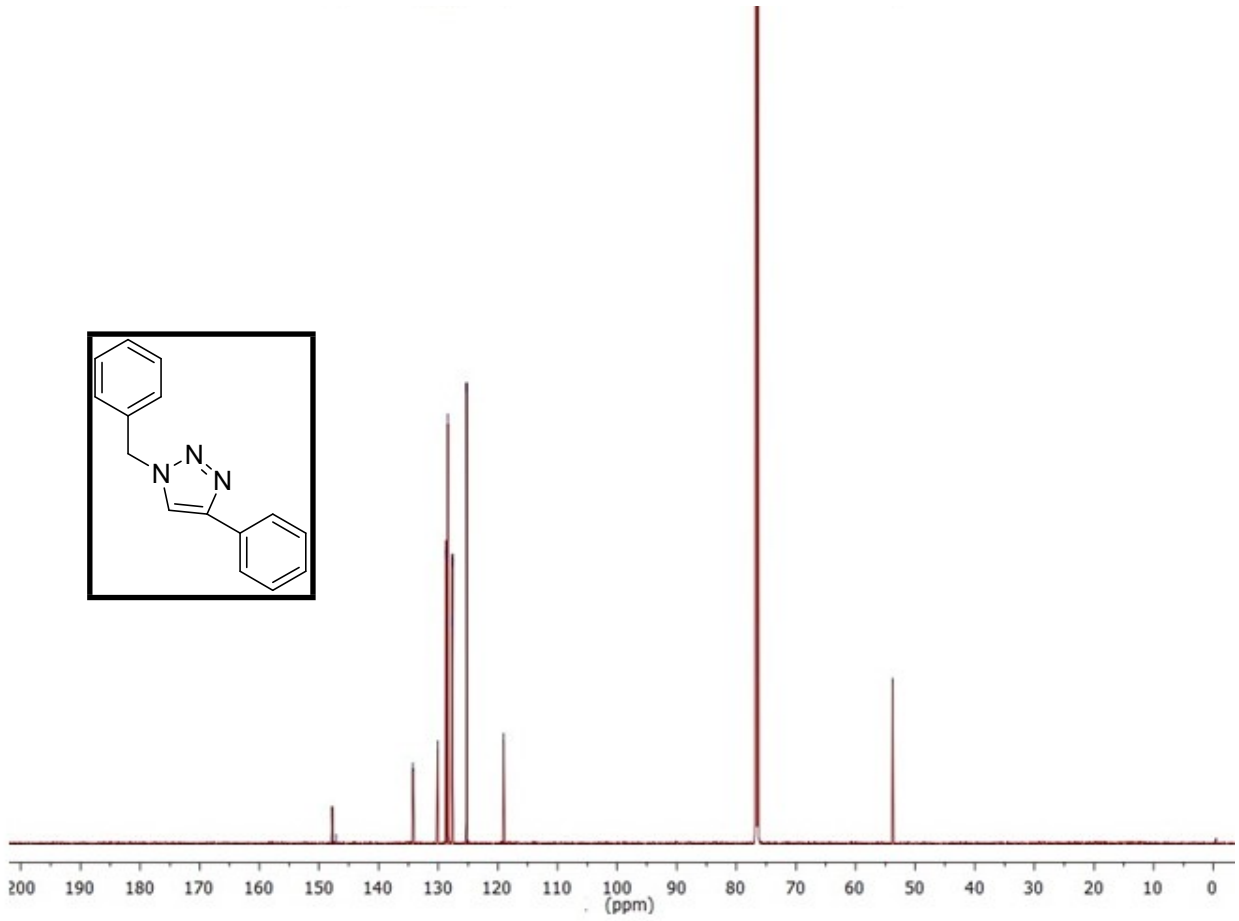
^{13}C NMR spectra of the compound P_3:



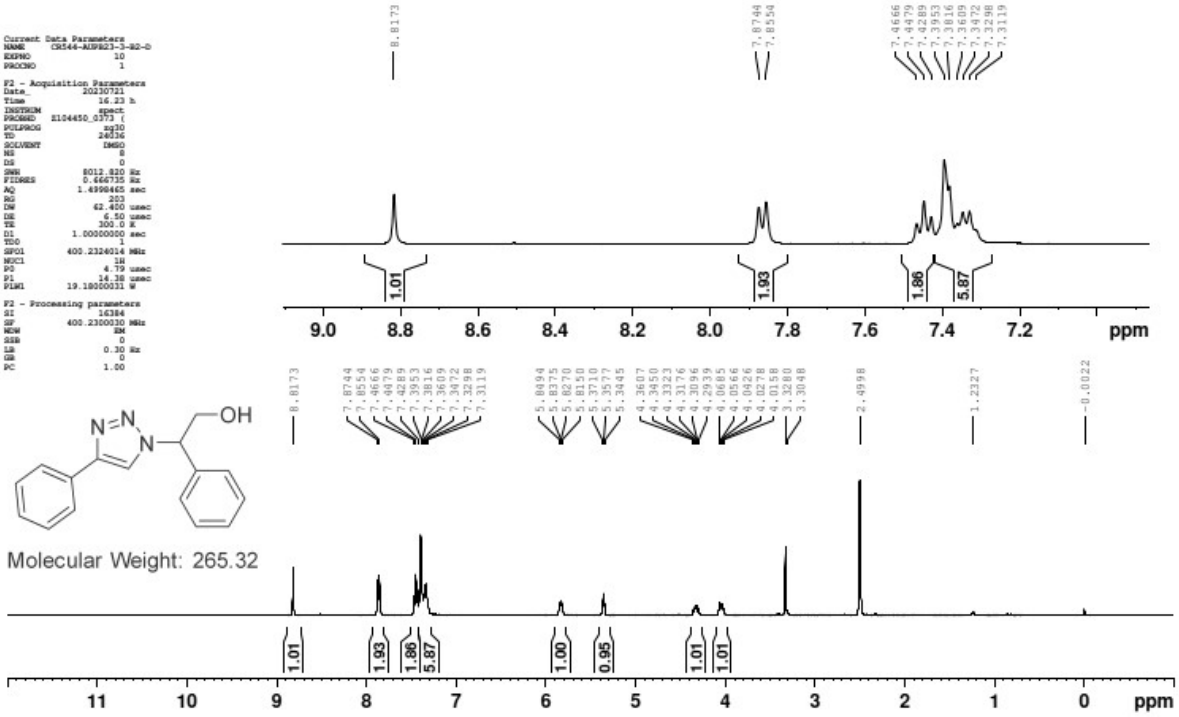
^{13}C NMR spectrum of the compound P_4:



^{13}C NMR spectrum of the compound P_4:



^{1}H NMR Spectrum of the Compound P_5:



13 C NMR of the compound P_5: