

Click Synthesis of Dendronized Malonates for the Preparation of Amphiphilic Dendro[60]fullerenes

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Electronic Supporting Information

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1. Synthesis of azides **6** and **7**

Isopropylidene-2,2-bis(methoxy)propionic acid, compound **2**. In a 250 mL round bottom flask equipped with a magnetic stirrer and conditioned with nitrogen atmosphere 15 g (111.8 mmol) of Bis-MPA and 0.42 g (3.02 mmol) of *p*-Toluensulfonic acid were dissolved in 75 mL of dry acetone and stirred at room temperature for 30 minutes. Then 17.4 g (20.5 mL, 167.1 mmol) of 2,2-dimethoxypropane was added and the reaction mixture was stirred at room temperature for 2 h. The reaction was quenched with K₂CO₃ (1.7 g, 12.1 mmol). The solvent was removed by distillation and the residue was dissolved in 100 mL of DCM and washed with distilled water (3 x 50 mL). The product was obtained pure as a white solid in 90% yield (11.8 g, 73.8 mmol). ¹H-NMR (500 MHz, CDCl₃, δ = ppm): 10.23 (Br, 1H, OH); 4.21 (d, J = 15.0 Hz, 2H); 3.69 (d, J = 15.0 Hz, 2H); 1.46 (s, 3H); 1.43 (s, 3H); 1.23 (s, 3H). ¹³C-NMR (APT, 100 MHz, CDCl₃, δ = ppm): 180.26 (C=O), 98.35 (O-C-O), 65.86, 41.76, 25.18, 22.00, 18.45. Characterization is in accordance with the literature. [Ref. 48 in main article].

(2,2,5-trimethyl-1,3-dioxan-5yl)methanol, compound **4**. In a 250 mL round bottom flask equipped with a magnetic stirrer and conditioned with nitrogen atmosphere 10 g (82 mmol) of 2-(hydroxymethyl)-2-methylpropane-1,3-diol and 0.1 g (0.52 mmol) of *p*-Toluensulfonic acid were dissolved in 75 mL of dry acetone and stirred at room temperature for 1 h. Then 12.88 g (15.4 mL, 123.7 mmol) of 2,2-dimethoxypropane was added and the reaction mixture was stirred at room temperature for 4 h. The reaction was quenched with K₂CO₃ (0.4 g, 2.9 mmol). The solvent was removed by distillation and the residue was dissolved in 100 mL of DCM and washed with distilled water (3 x 50 mL). The product was obtained pure as a clear oil in 92% yield (12.1 g, 75.4 mmol). ¹H-

NMR (400 MHz, CDCl₃, δ = ppm): 3.70 (s, 2H); 3.69 (d, J = 11.9 Hz, 2H); 3.62 (d, J = 11.9 Hz, 2H); 2.21 (br, 1H); 1.45 (s, 3H); 1.40 (s, 3H); 0.84 (s, 3H). **¹³C-NMR (APT, 100 MHz, CDCl₃, δ = ppm):** 17.58 (CH₃), 20.15 (CH₃), 27.28 (CH₃), 34.74 (C), 65.97 (CH₂), 66.35 (CH₂), 97.97 (O-C-O). **FT-IR-ATR (cm⁻¹):** 3418.4, 2990.6, 2939.0, 2868.5, 1453.1, 1370.6, 1265.5, 1205.7, 1151.4, 1082.5, 1035.4, 932.9, 909.9, 826.6, 730.8, 520.4. Characterization is in accordance with the literature. [Ref. 48 in main article].

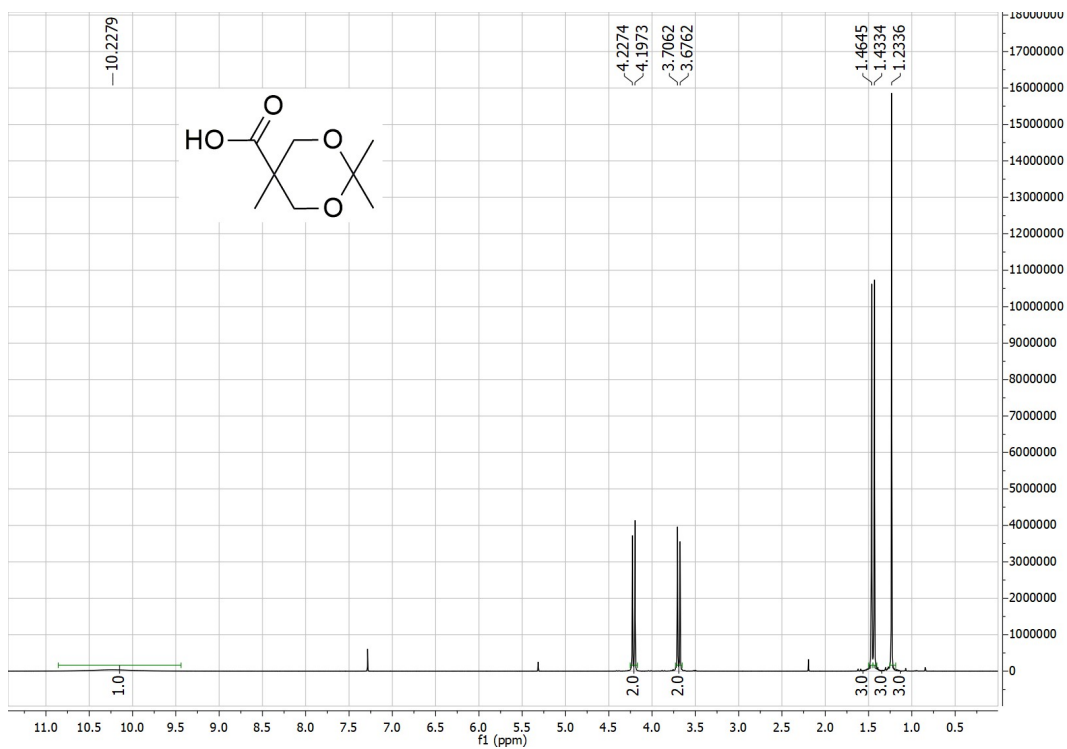
Tosylate 5. In a 50 mL round bottom flask, 2.0 g (12.5 mmol) of cetonide **4** was mixed with 6 mL of pyridine, then a solution of p-toluenesulfonyl chloride (2.38 g, 12.54 mmol) in 3 mL of pyridine was added. The reaction mixture was stirred at 100° C for 2 h. Reaction was poured into ice-water (200 mL) and extracted with Et₂O (3 X 75 mL). The organic layers were mixed and dried with anhydrous Na₂SO₄ and the solvent was removed by vacuum distillation. Product was purified by column chromatography Hex-EtOAc (100:0 to 7:3) to obtain 2.94 g of pure product as a wax white solid, 75 % yield. **MS-ES-EPI (M + H, low resolution):** found = 315.1 (calculated: 315.1266), (M + Na) found = 337.1 (calculated: 337.1086)

5-(azidomethyl)-2,2,5-trimethyl-1,3-dioxane, compound **6**. In a 50 mL round bottom flask, 2.5 g (7.99 mmol) of tosylate **5** was dissolved in 30 mL of DMF-H₂O (8:1) and sodium azide was added (0.57 g, 8.79 mmol). Reaction mixture was stirred at 110° C for 16 h, until no starting material was observed by TLC. The mixture was poured into 100 mL of water and extracted with Et₂O (3 x 75 mL). solvent was removed by distillation and the product was purified by column chromatography on silica gel with Hexane-EtOAc (95:5) as eluent, obtaining 1.33 g (7.2 mmol, 57.6%) of pure product as a clear oil. **¹H-NMR (400 MHz, CDCl₃, δ = ppm):** 3.63 (d, J = 12.8 Hz, 2H); 3.60 (d, J = 12.8 Hz, 2H); 3.54 (s, 2H); 1.45 (s, 3H); 1.42 (s, 3H); 0.84 (s, 3H). **¹³C-NMR (APT, 100 MHz, CDCl₃, δ = ppm):** 18.04 (CH₃), 19.65 (CH₃), 27.70 (CH₃), 34.43 (C), 55.99 (CH₂), 66.68 (CH₂). **FT-IR ATR (cm⁻¹):** 2095.4 (N₃) Characterization is in accordance with the reported literature. [Ref. 48 in main article].

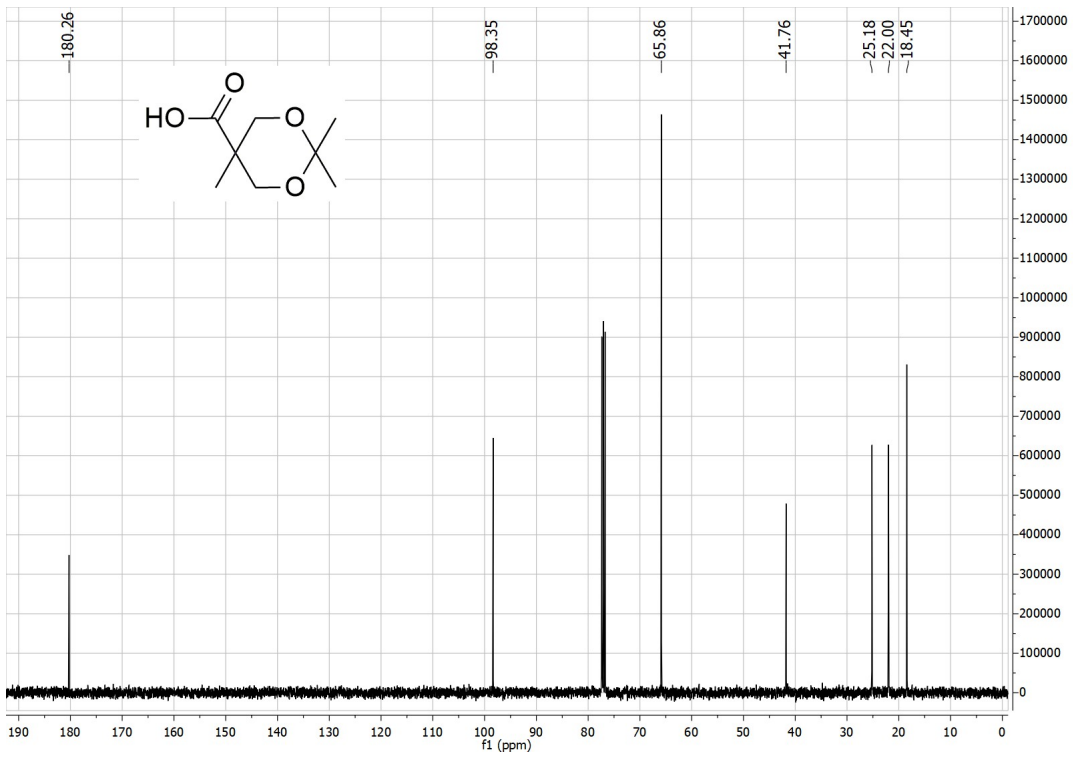
2-(azidomethyl)-2-methylpropane-1,3-diylbis(2,2,5-trimethyl-1,3-dioxane-5-carboxylate), compound **7**. To a solution of 1.2 g (6.48 mmol) of azide **6** in 30 mL of MeOH, 0.1 g of DOWEX-H + resin was added. This mixture was stirred at 40° C for 45 minutes, then it was filtered through a glass porous funnel. The solvent was removed by vacuum distillation and the resulting diol (0.937 g, 6.46 mmol, 99%) was dissolved in 25 mL of dry CH₂Cl₂ and conditioned under nitrogen. To this mixture, 2.36 g (13.57 mmol) of acid **2**, 1.33 g (4.52 mmol) of DPTS and 0.16 g (1.3 mmol) of DMAP were added. The reaction mixture was stirred at 0° C for 40 minutes, then a solution of 2.93 g (14.21 mmol) of DCC in dry DCM was added dropwise. The reaction was allowed to reach room temperature and stirred for 48 h. The white precipitate (DCU) was removed by filtration and the solvent removed by vacuum distillation. The residue containing the desired product mixed with DPTS was dissolved in hot EtOAc to remove the DPTS by crystallization. This process was repeated 2 or 3 times before the final purification by column chromatography on silica gel (Hex-EtOAc, 9:1 to 7:3). The product was obtained as a clear oil, 2.54 g (5.56 mmol, 86%). **¹H-NMR (400 MHz, CDCl₃, δ = ppm):** 4.20 (d, J = 12.0 Hz, 4H); 4.10 (s, 4H); 3.67 (d, J = 12.0 Hz, 4H); 3.40 (s, 2H); 1.45 (s, 6H); 1.38 (s, 6H); 1.16 (2, 6H); 1.07 (s, 3H). **¹³C-NMR (APT, 100 MHz, CDCl₃, δ = ppm):** 17.69 (CH₃), 18.47 (CH₃), 21.53 (CH₃), 25.75 (CH₃), 40.03 (C), 42.24 (C), 55.15 (CH₂), 65.96 (CH₂), 66.14 (CH₂), 98.18 (O-C-O), 173.78 (C=O). **FT-IR-ATR (cm⁻¹):** 2939.8, 2875.7, 2102.5, 1732.2, 1197.9, 1151.2, 1120.9, 1077.9, 1039.7, 934.4, 828.7, 519.8. **FT-IR ATR (cm⁻¹):** 2104.3 (N₃), 1734.7 (C=O). **MS-ES-EPI (M + H, low resolution):** found = 458.3 (calculated: 458.2502), (M + Na) found = 480.3 (calculated: 480.5077).

2. Spectroscopic Data of all compounds

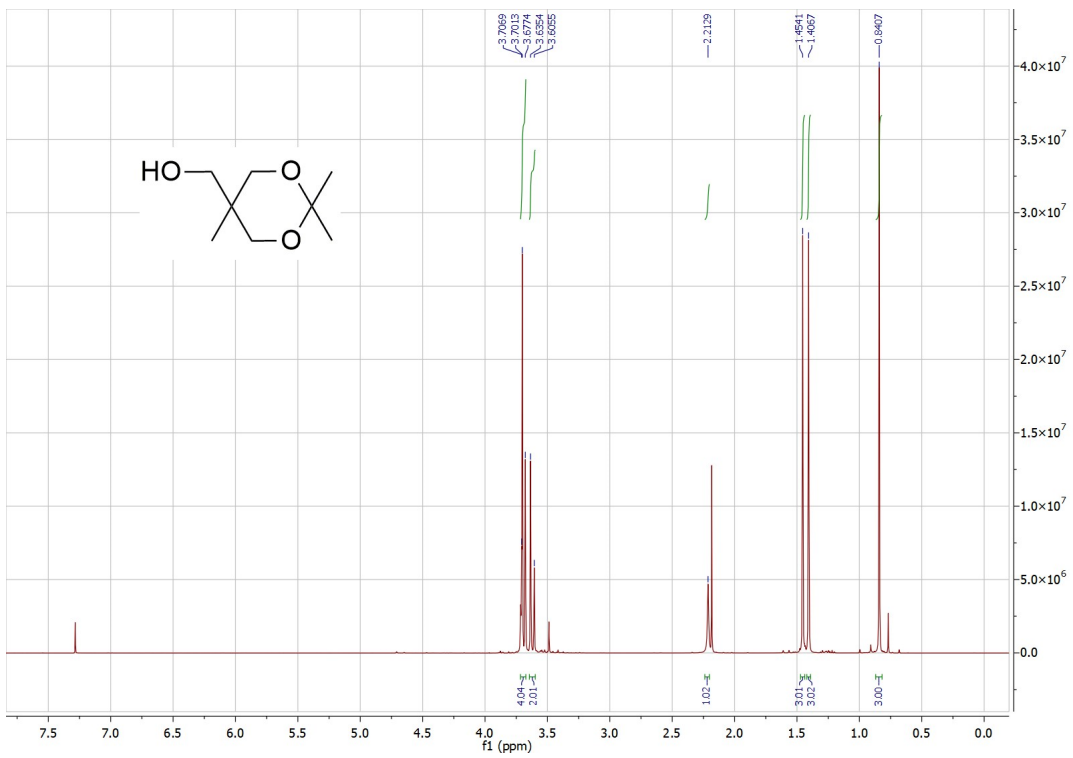
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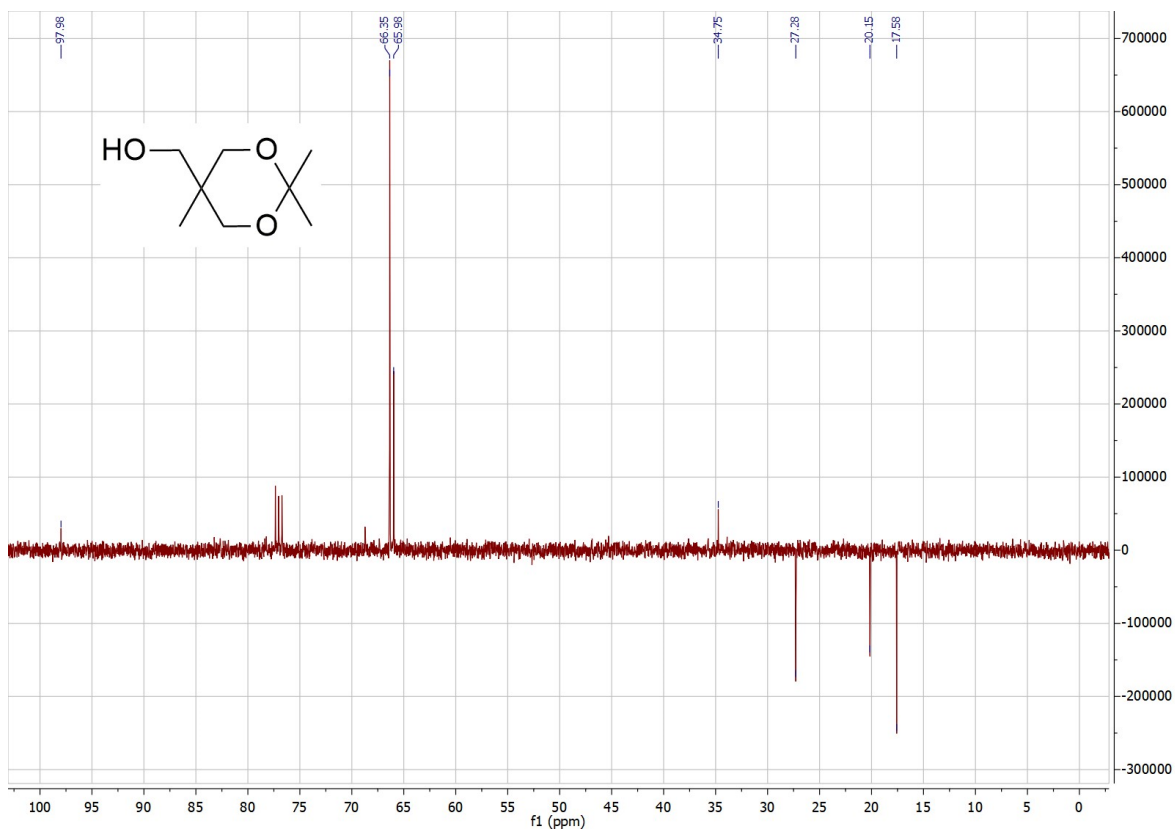
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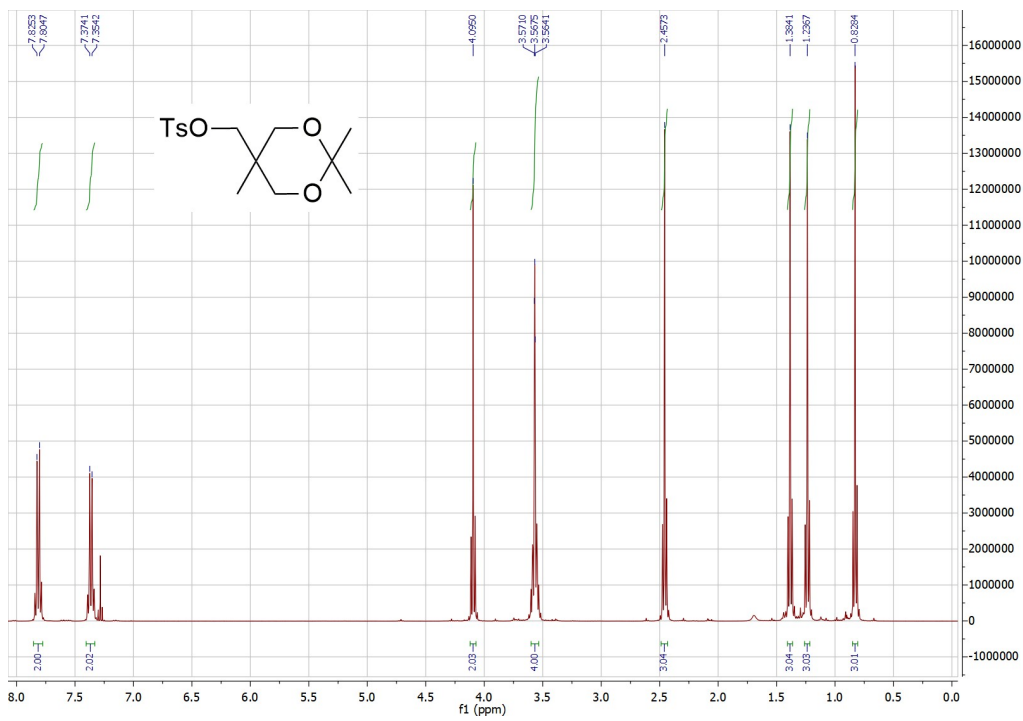
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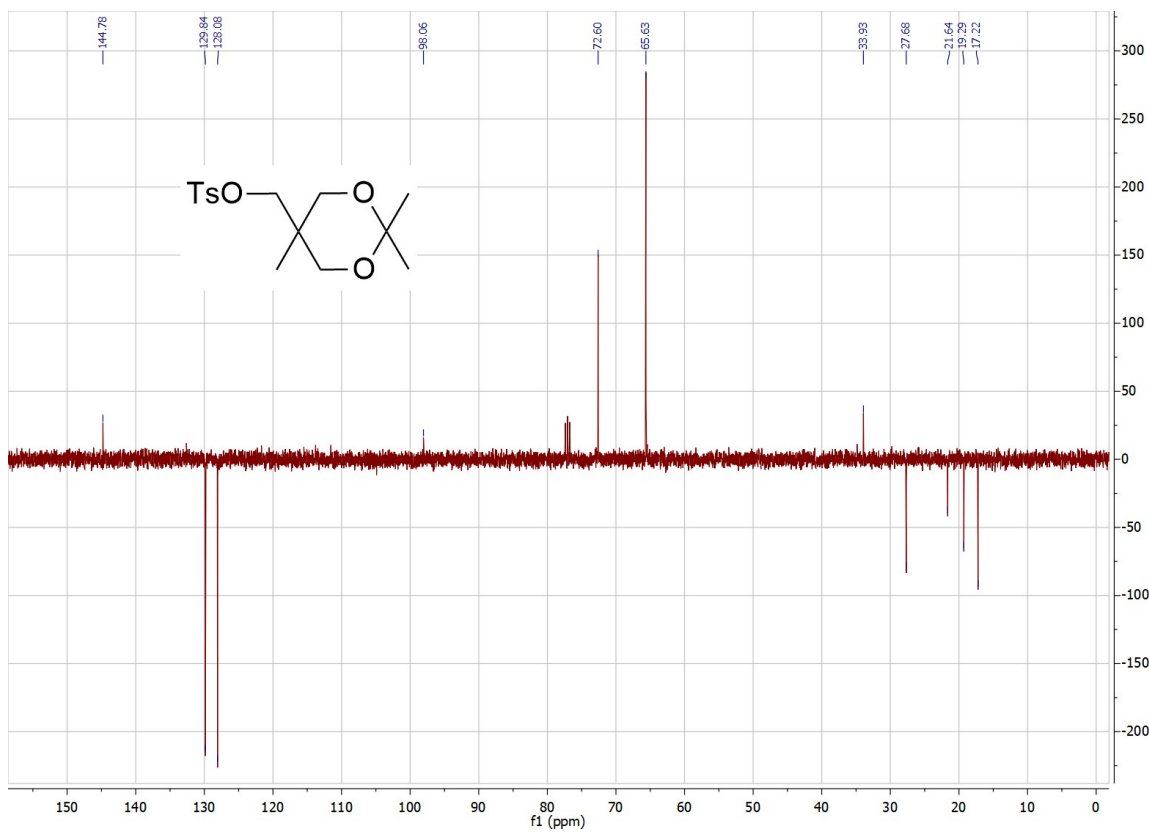
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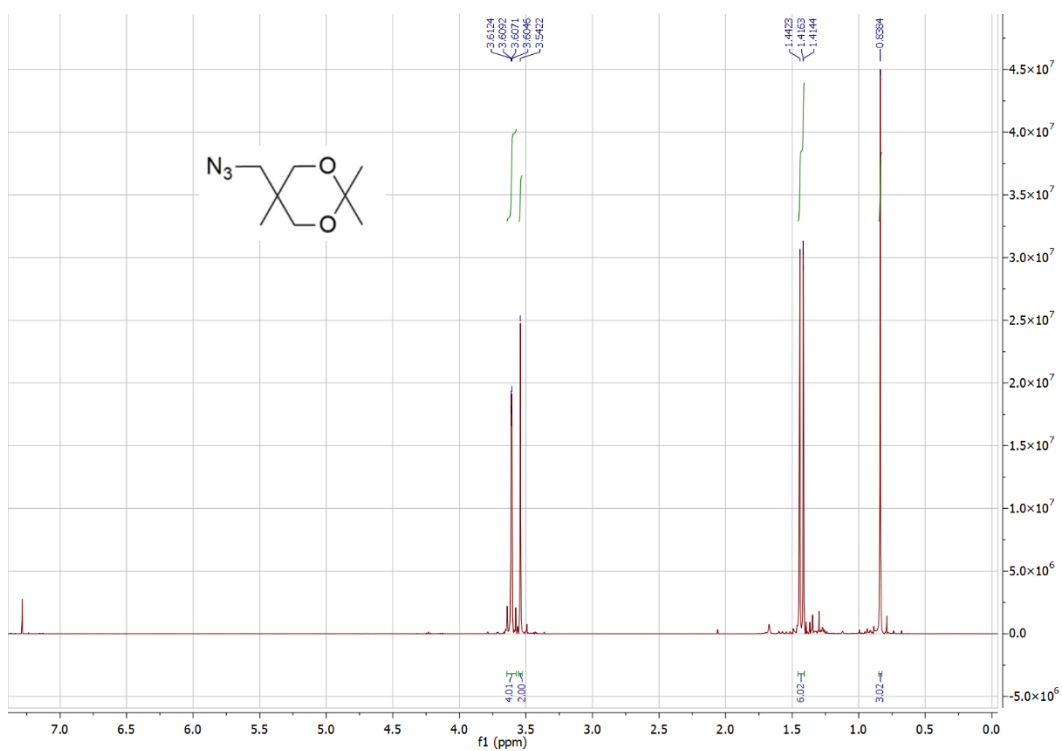
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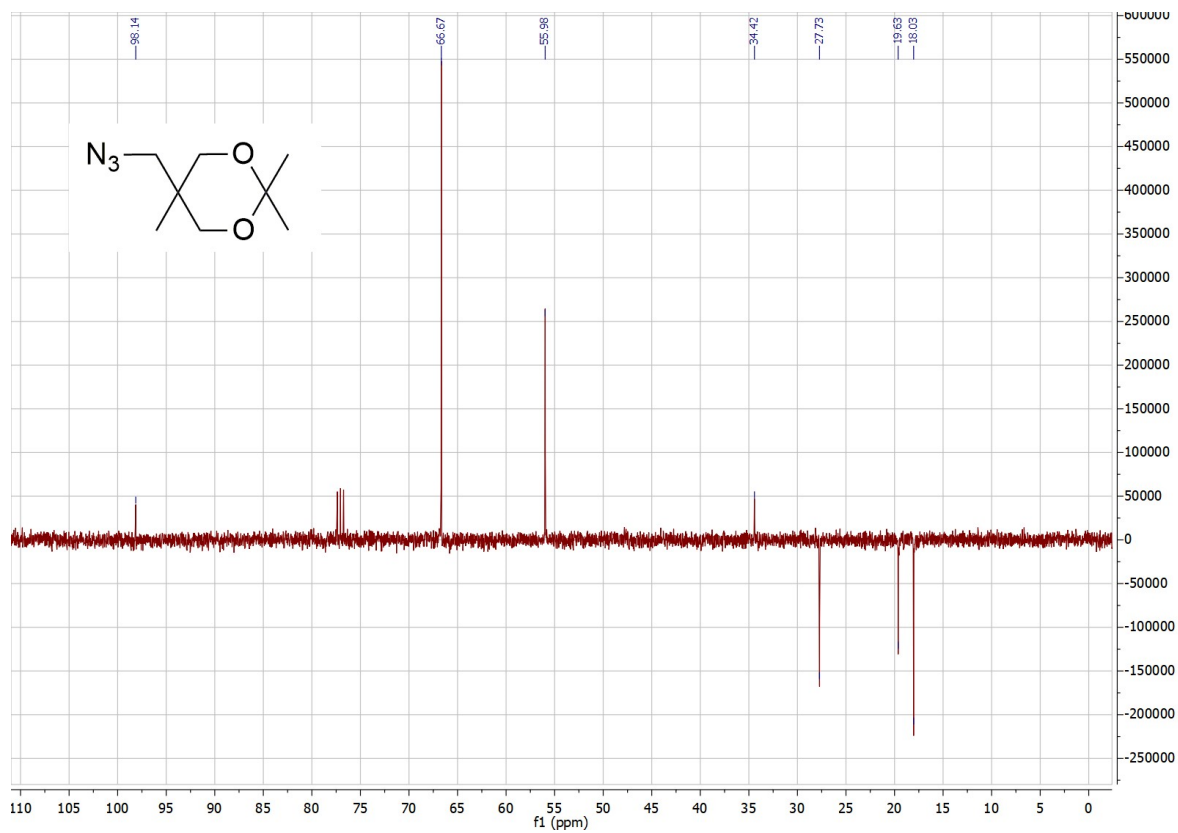
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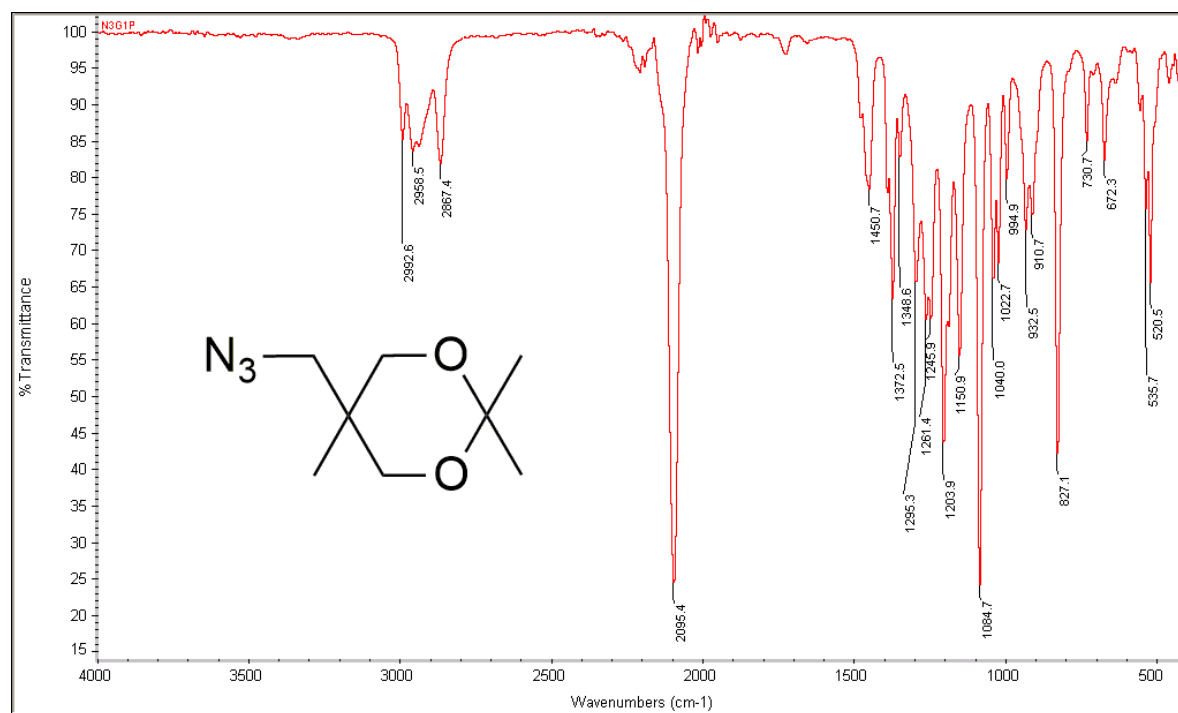
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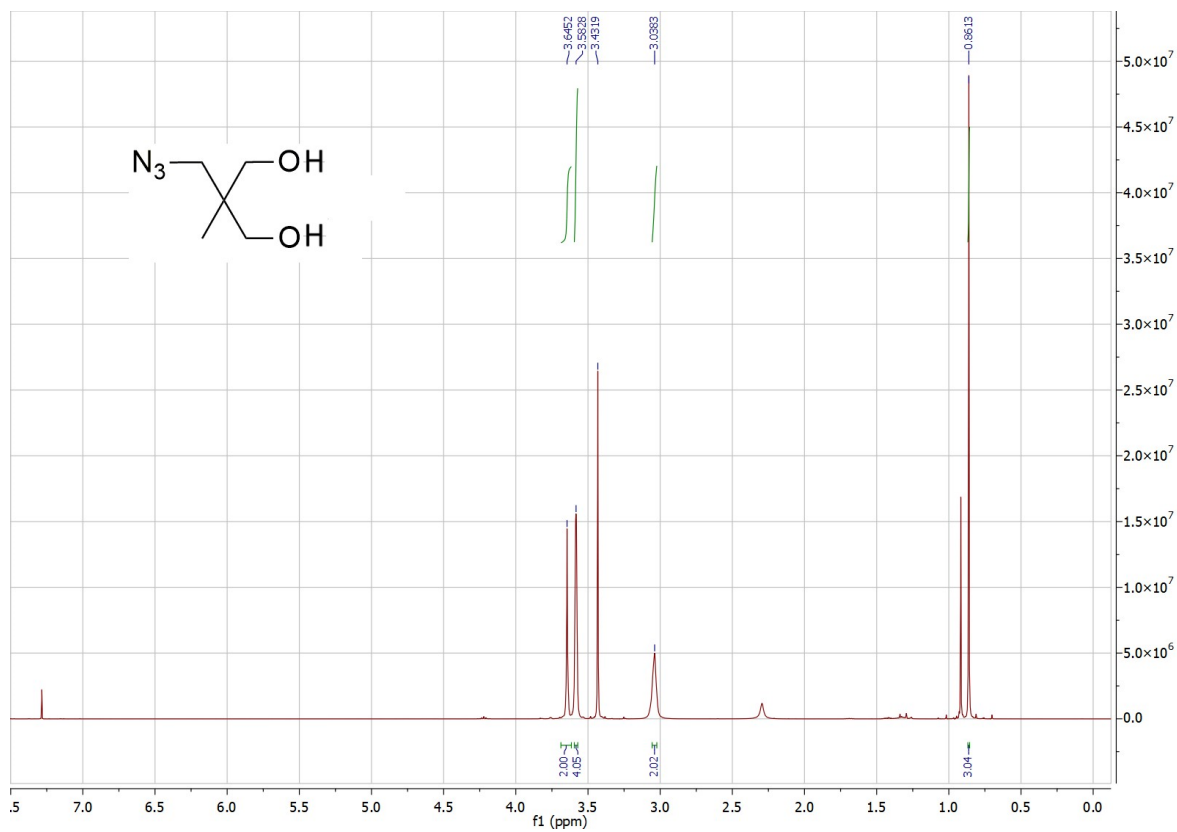
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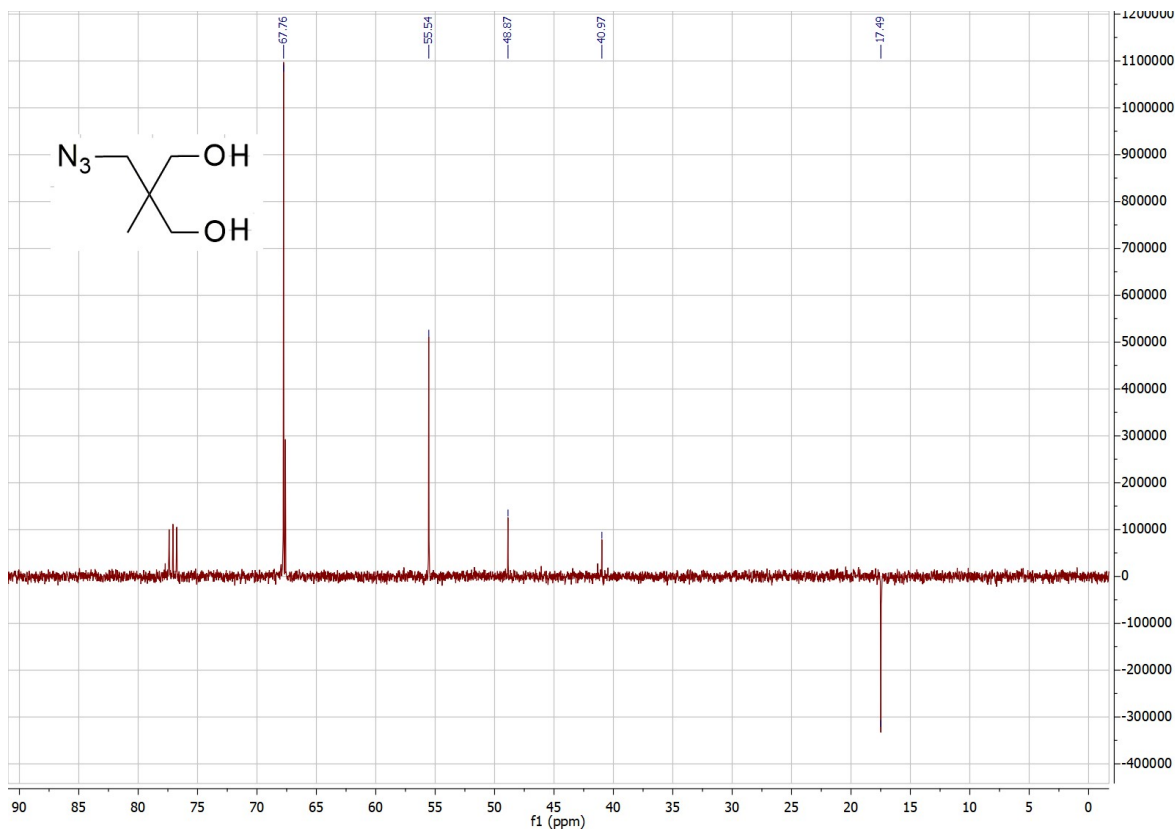
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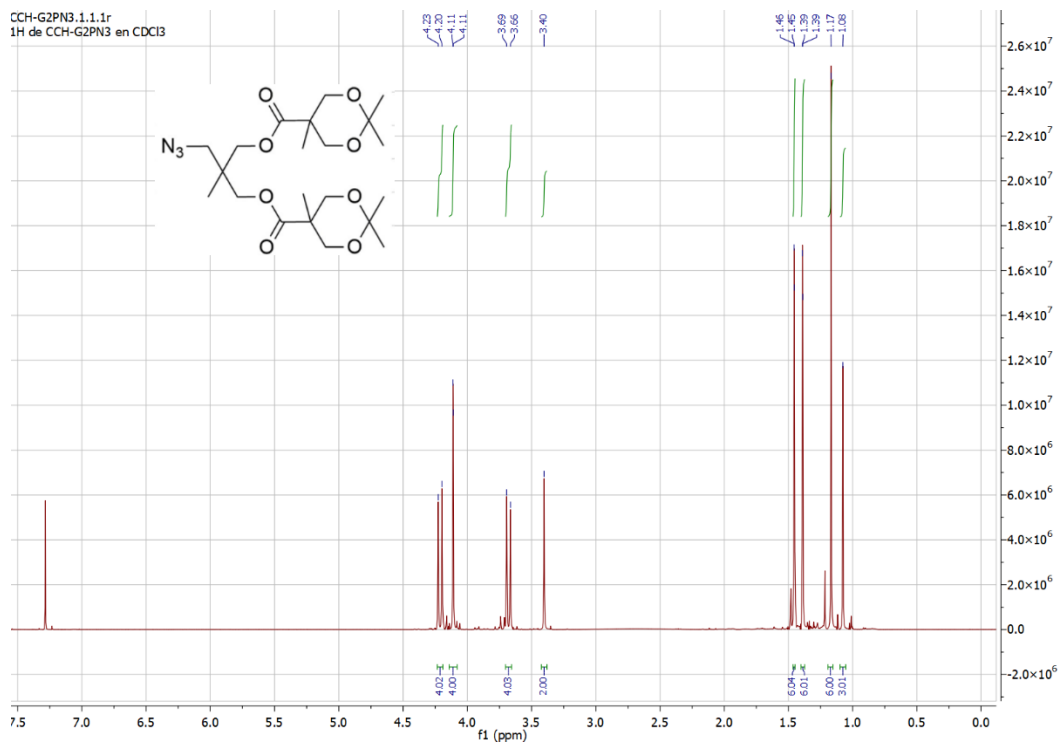
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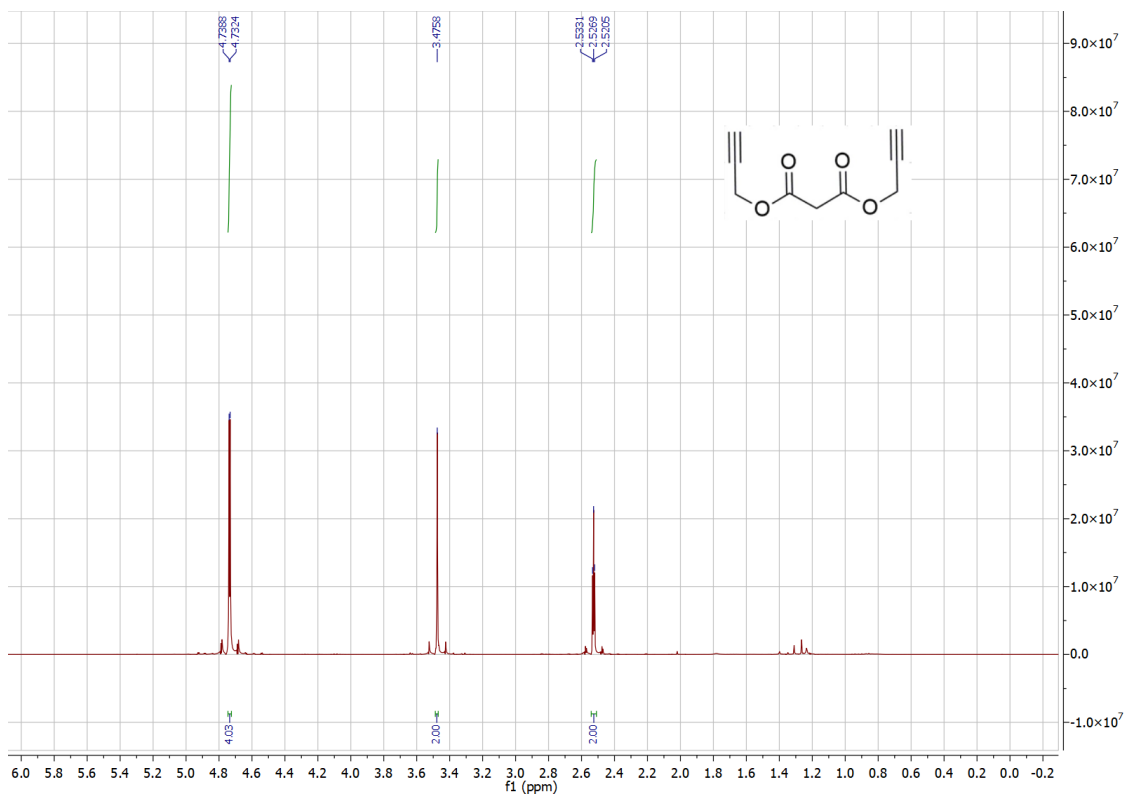
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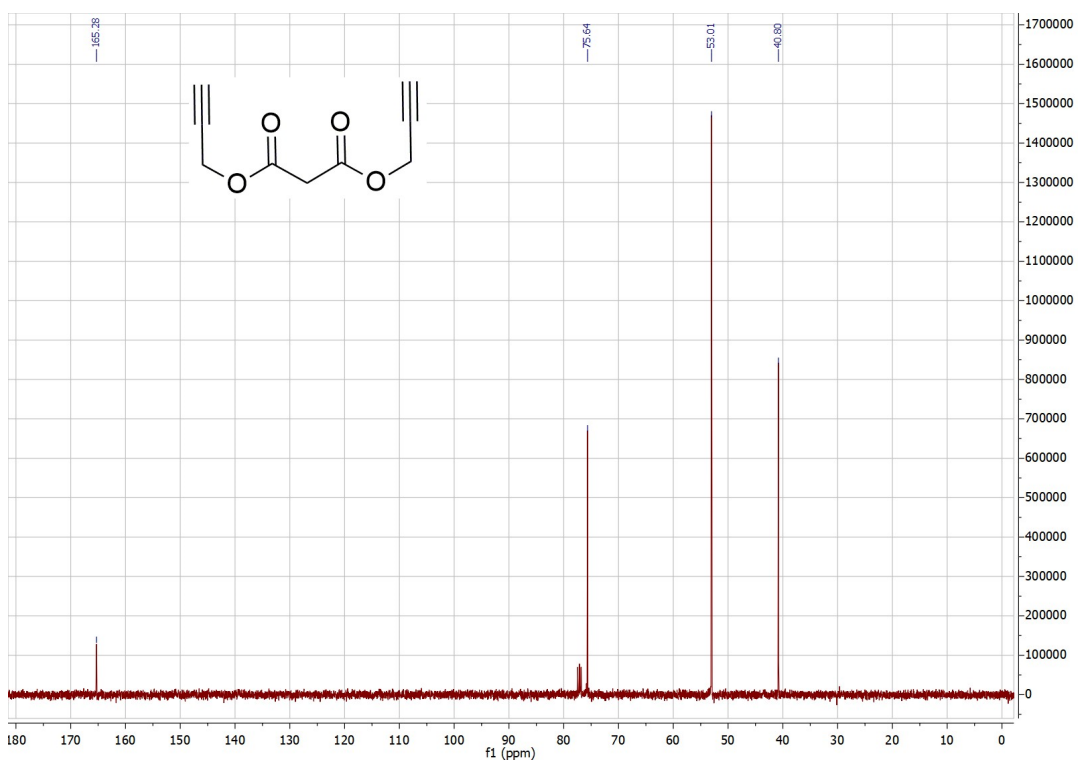
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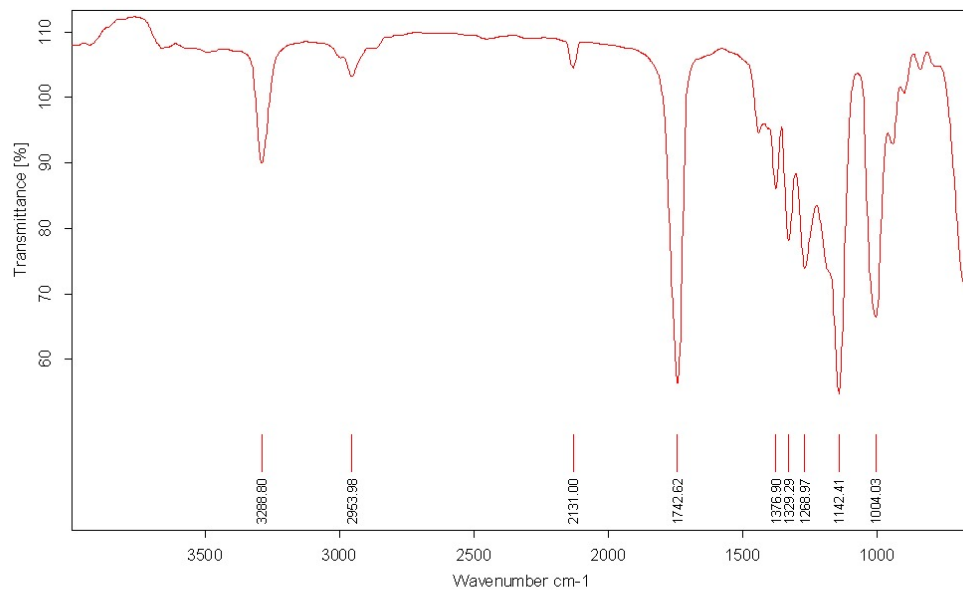
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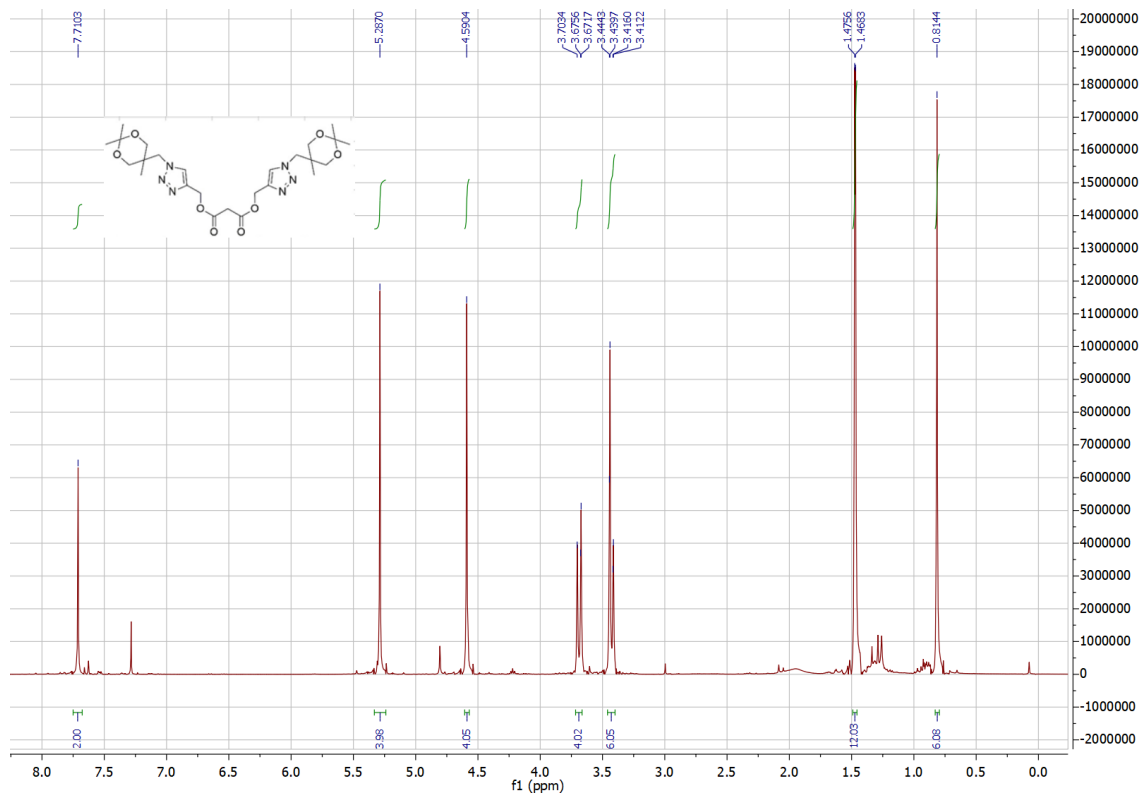


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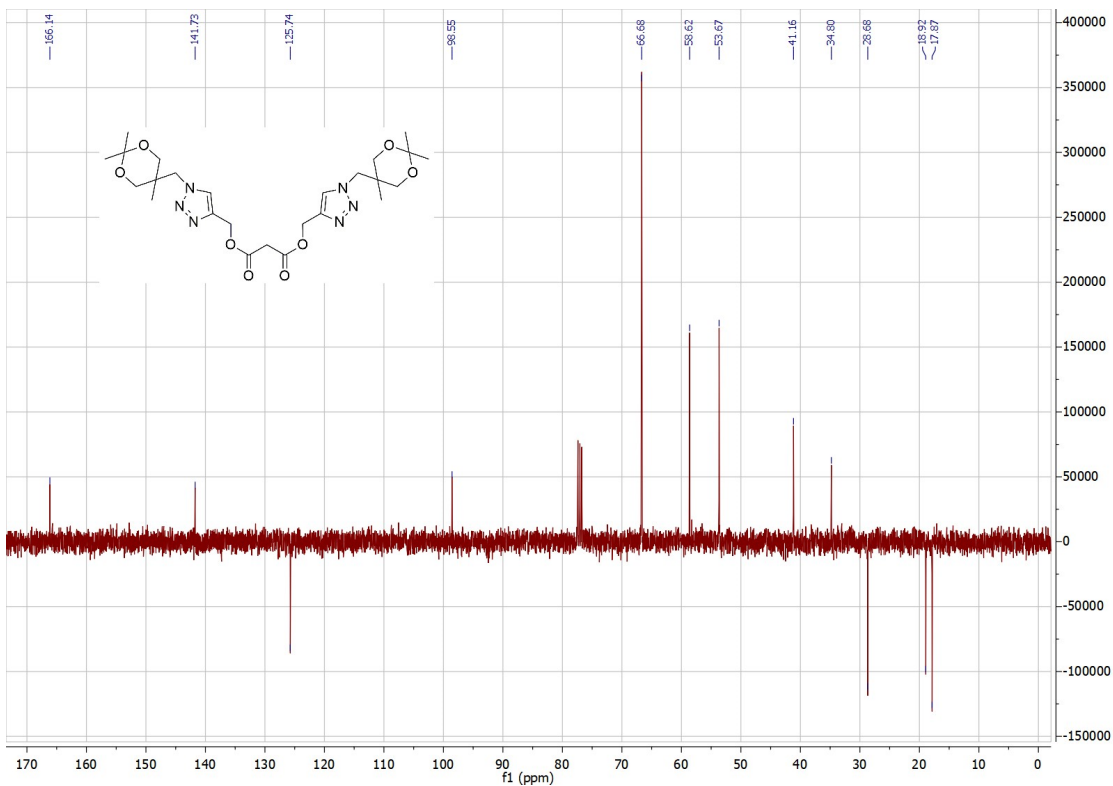


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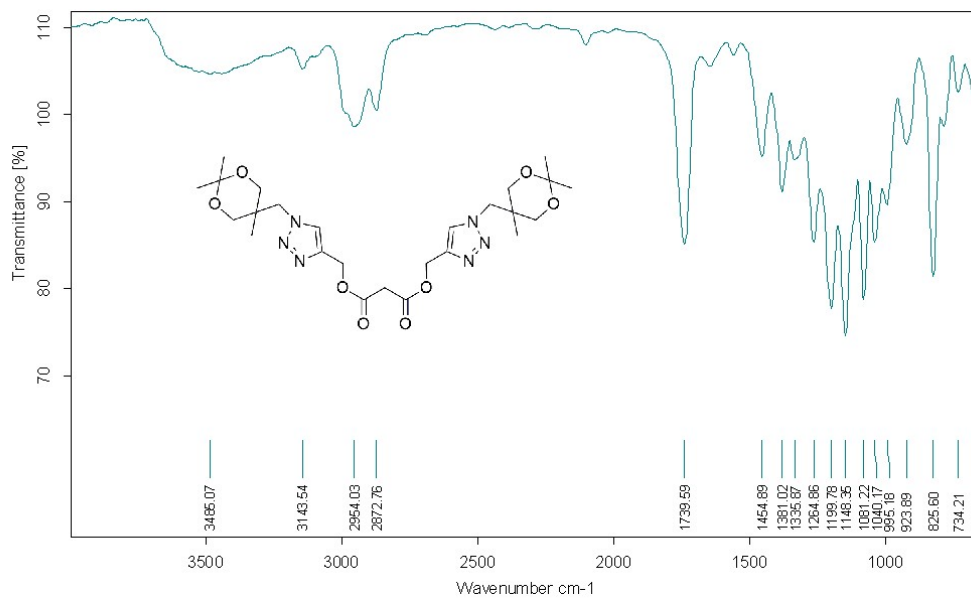
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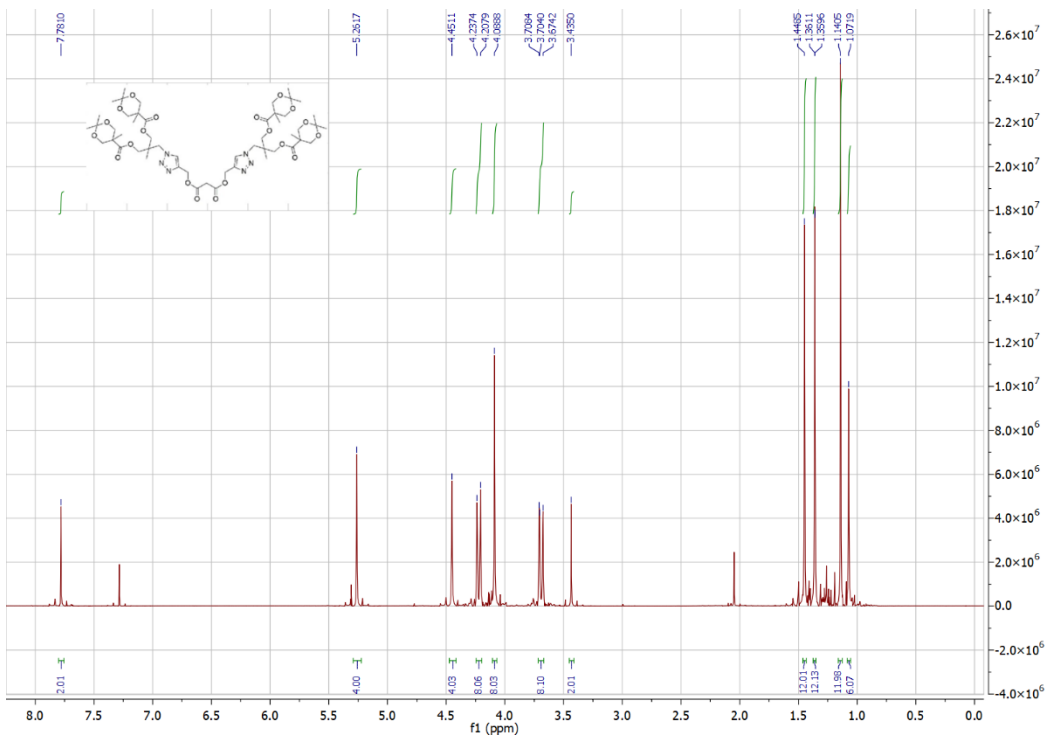


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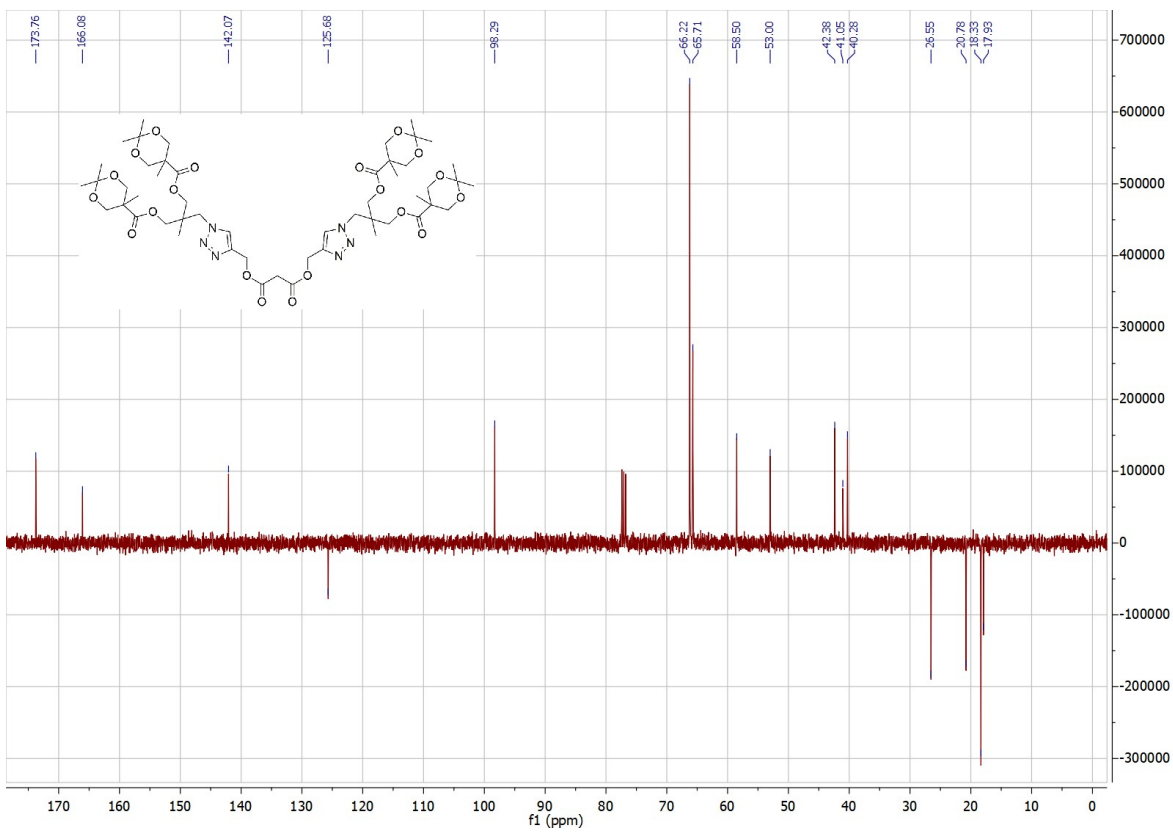


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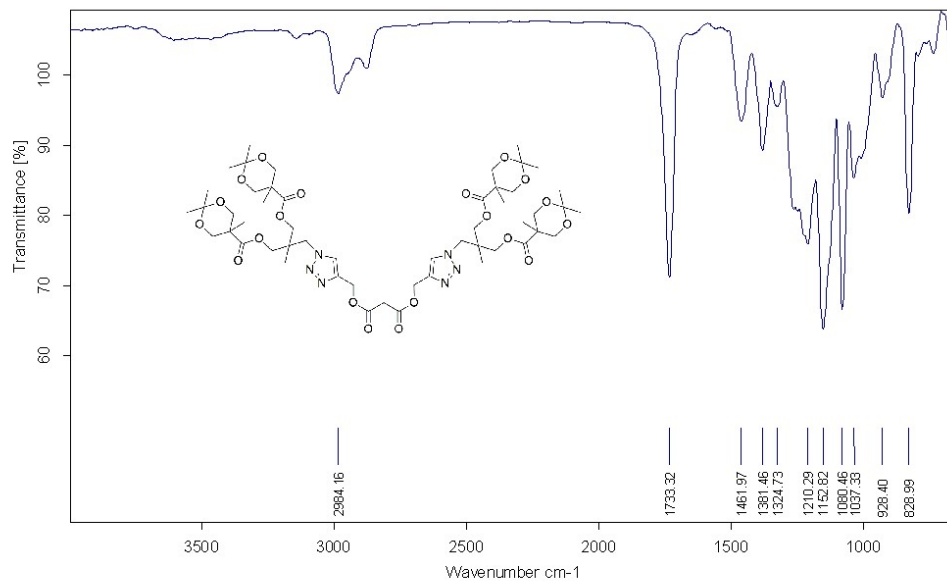
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¹³C- NMR of compound 11

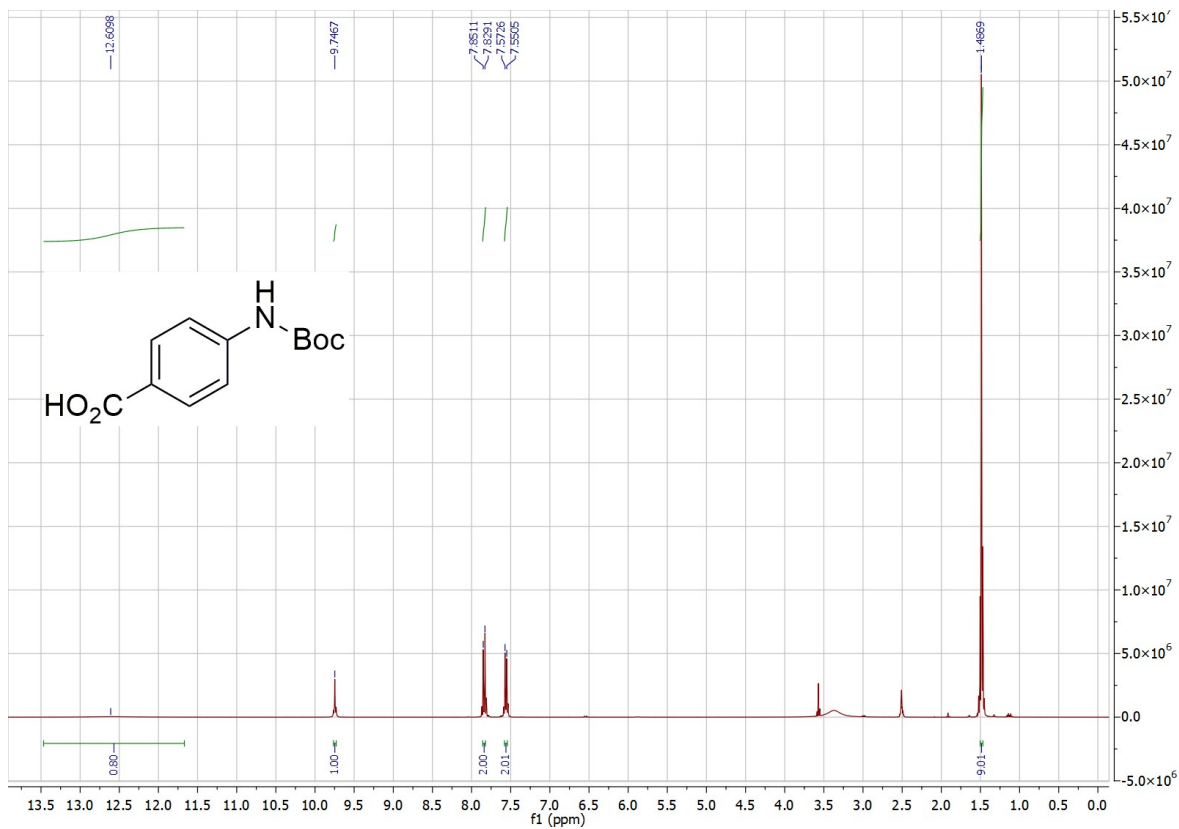


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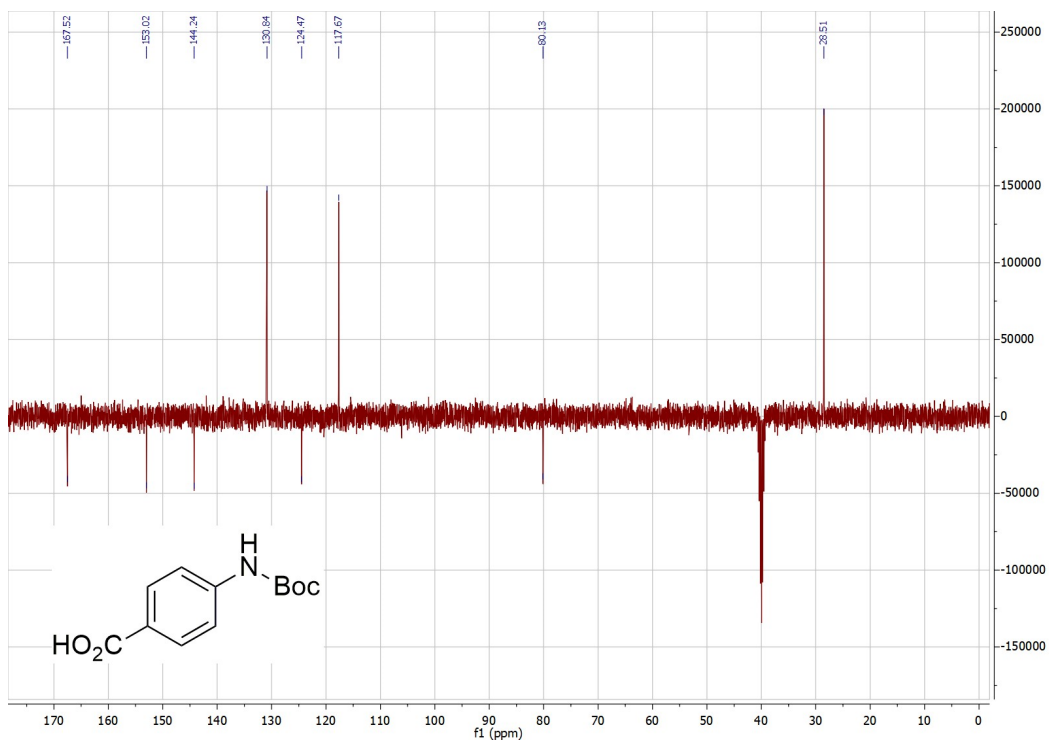


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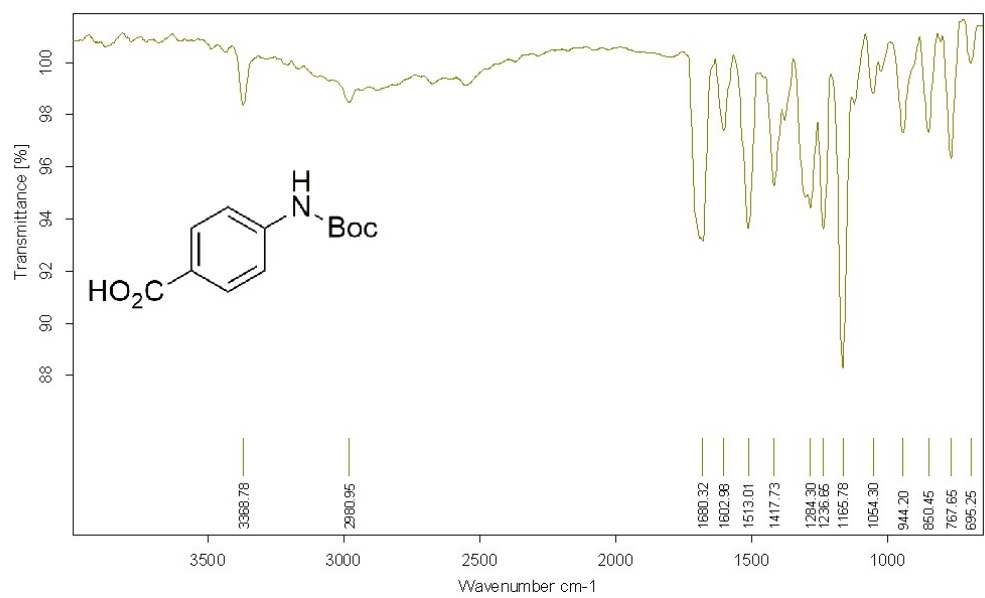
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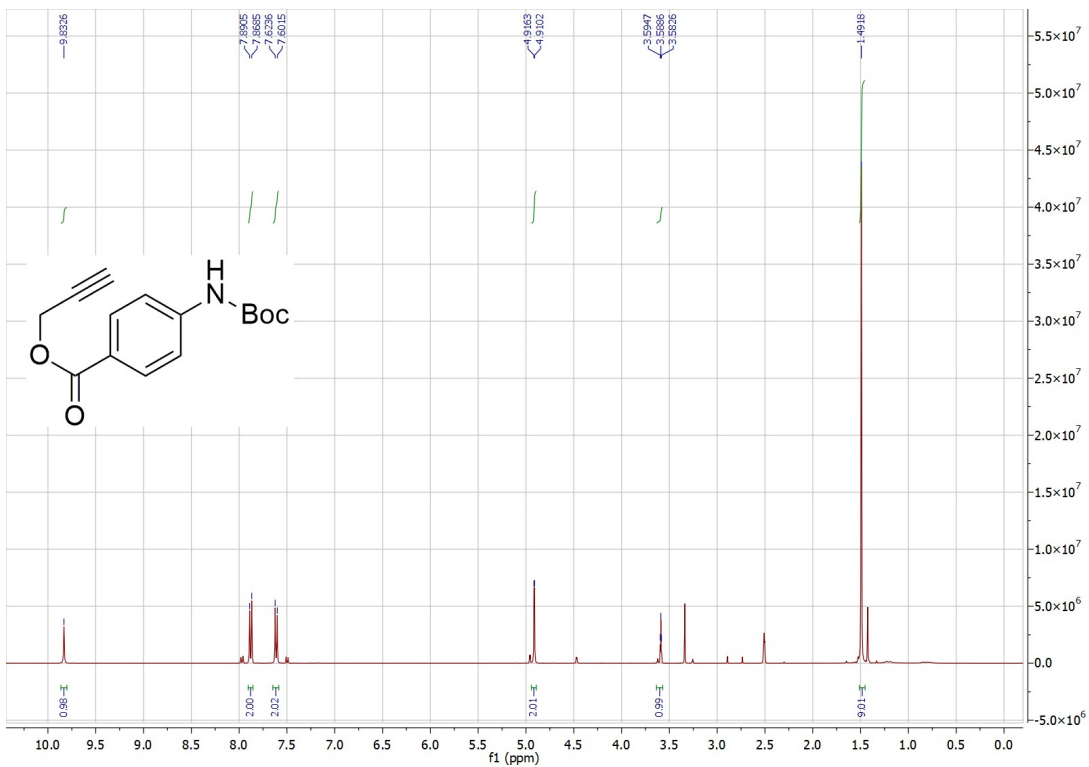


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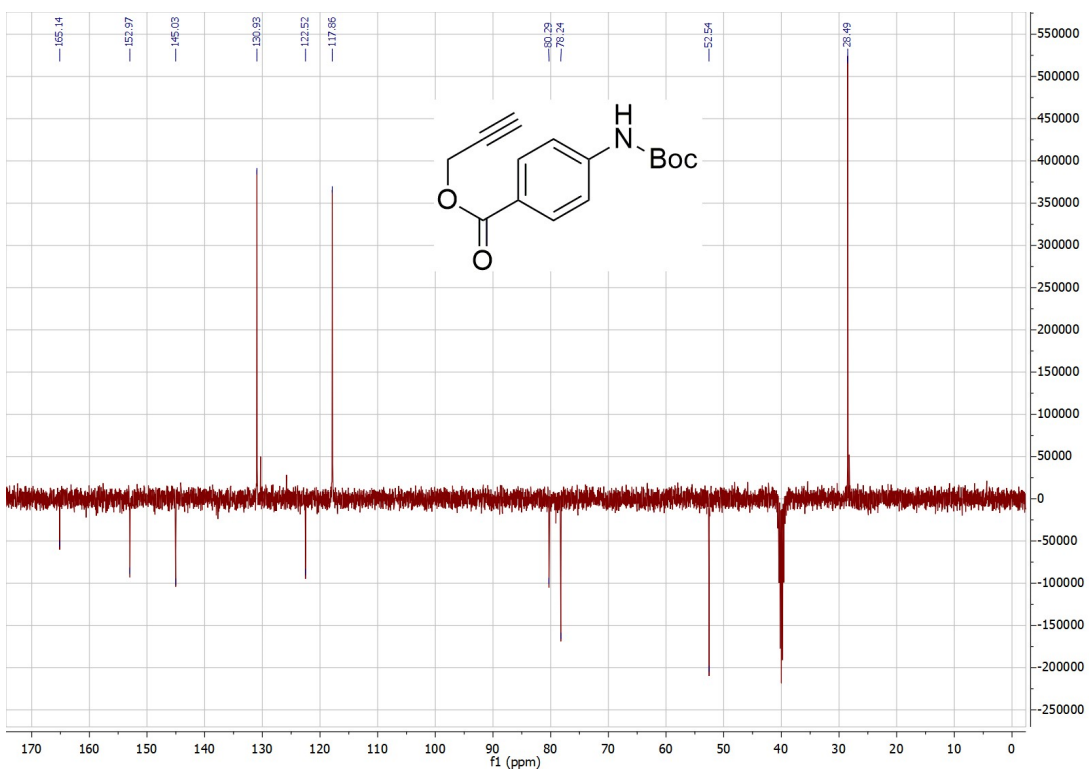


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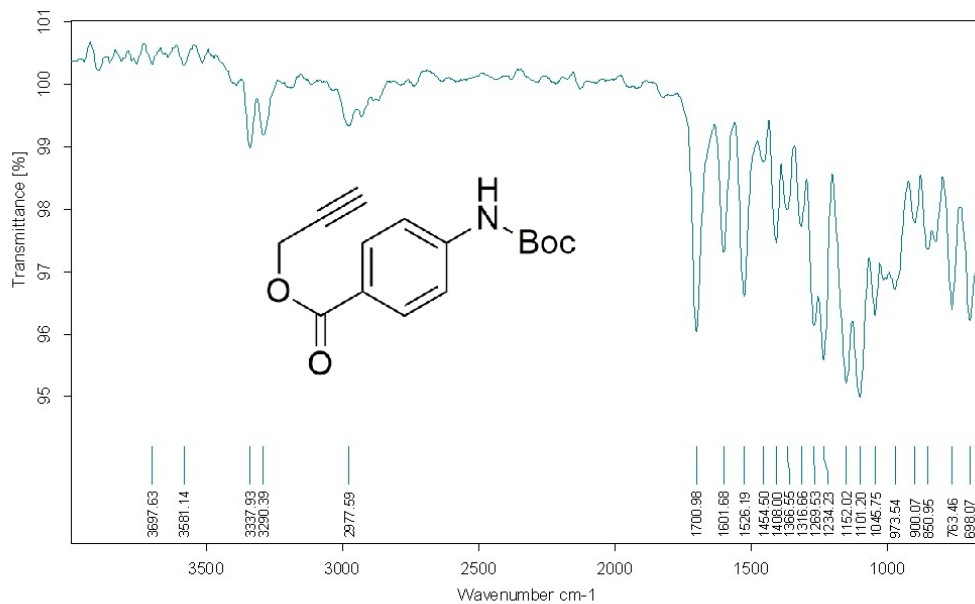
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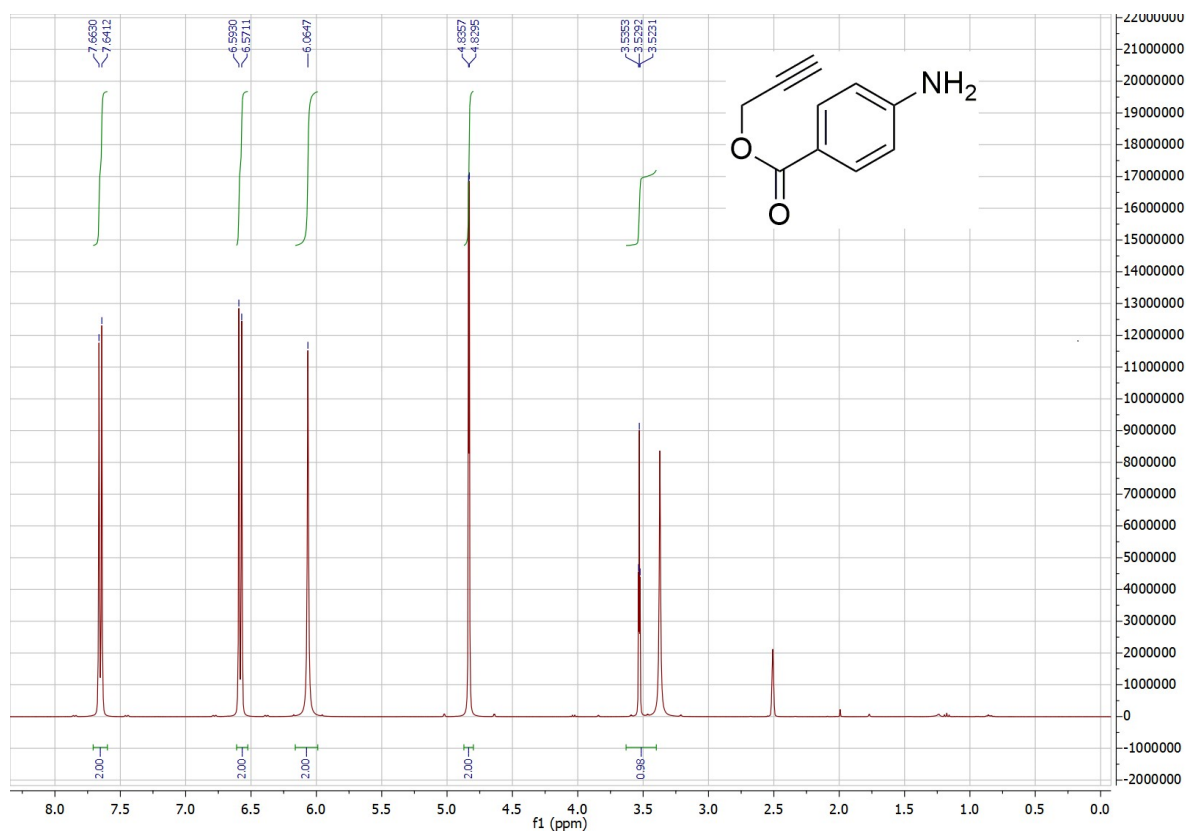
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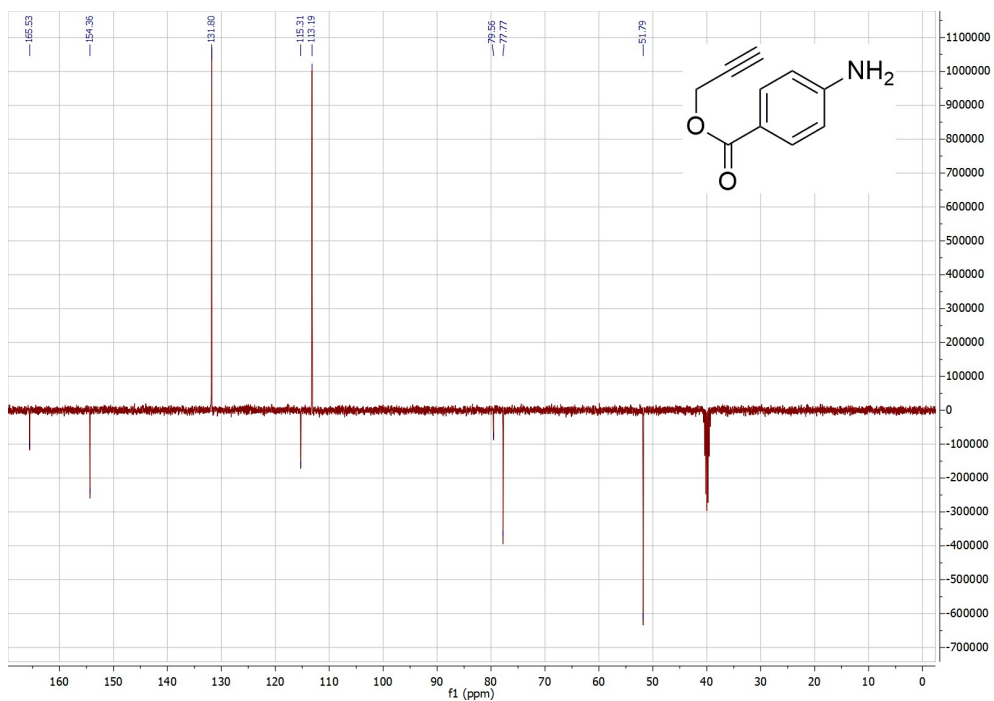
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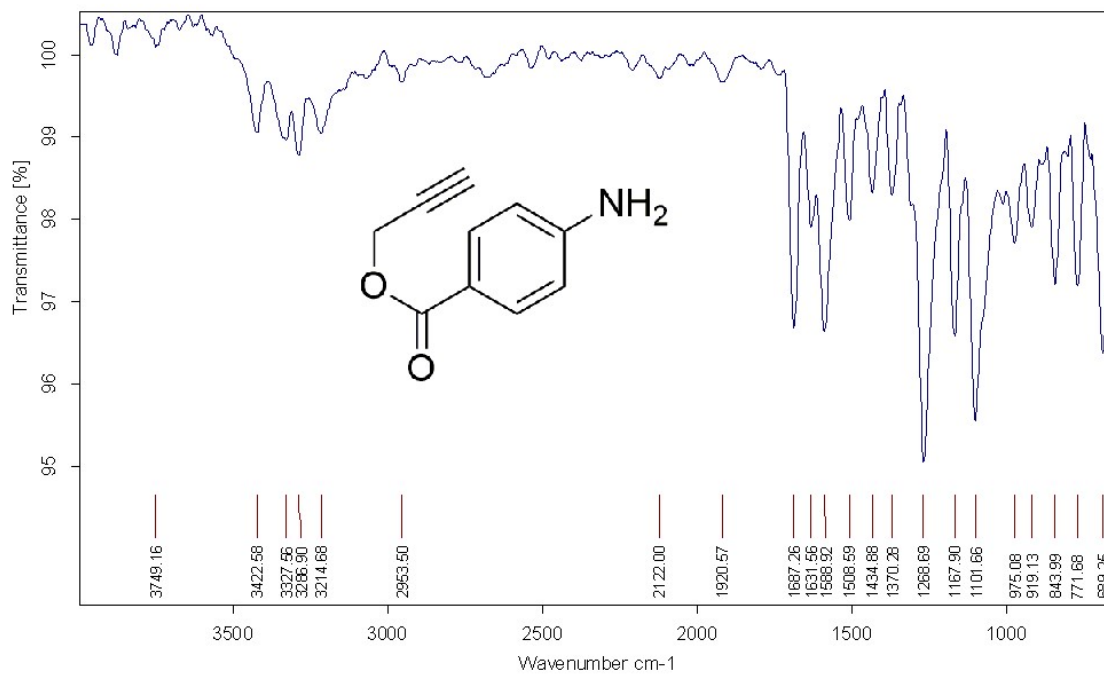
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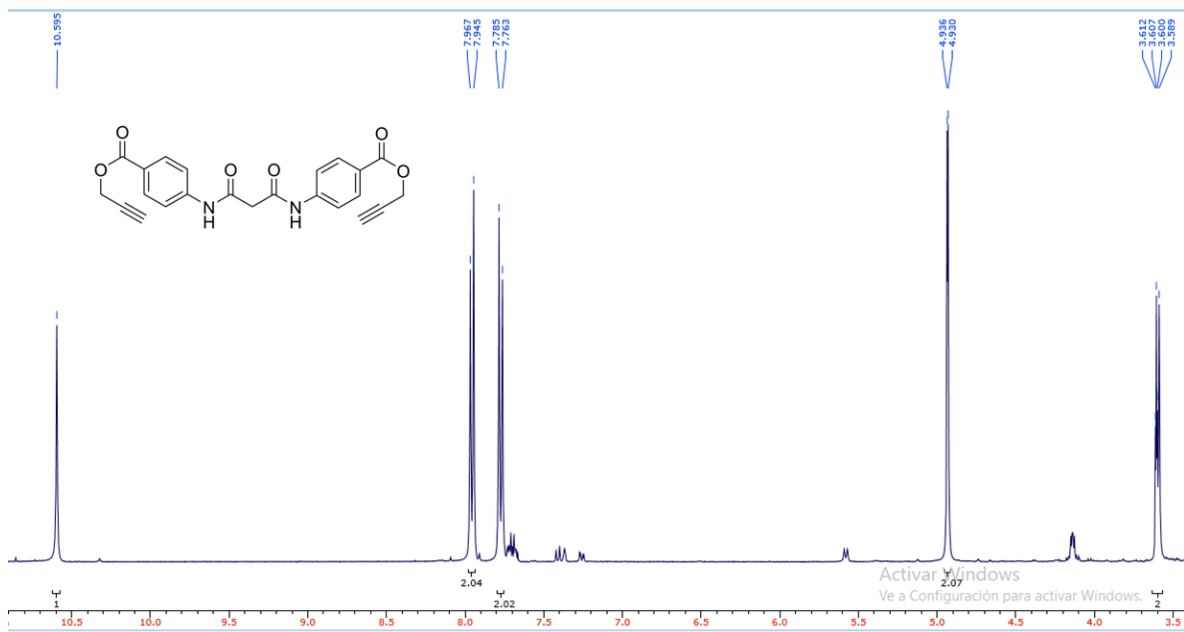


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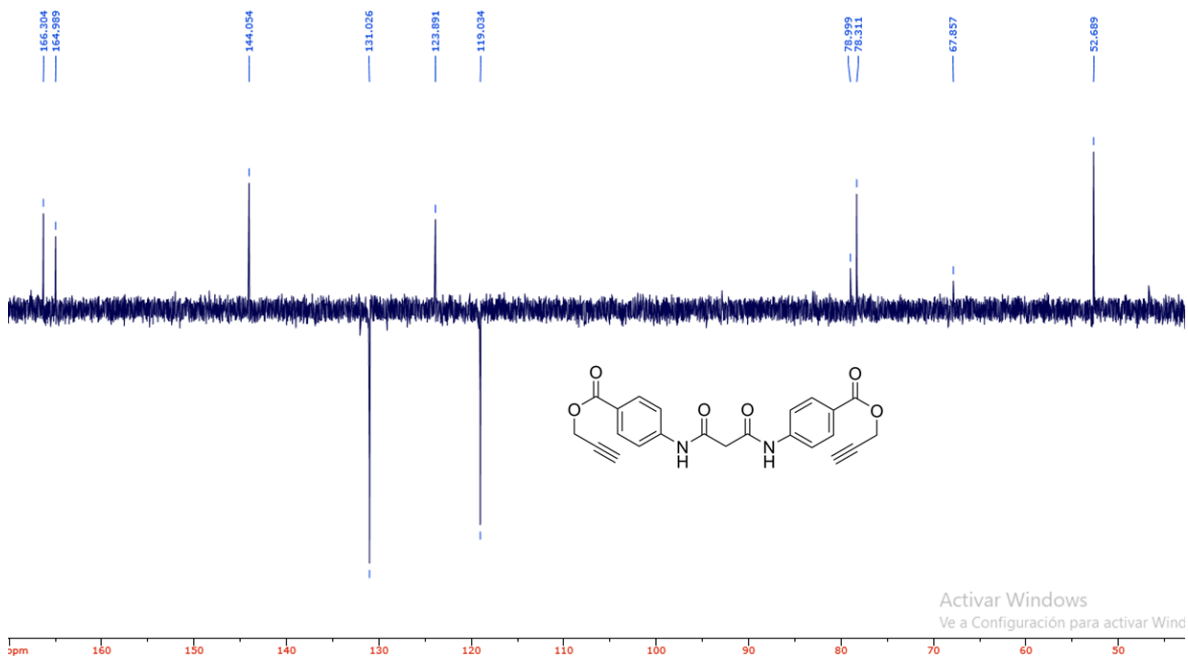


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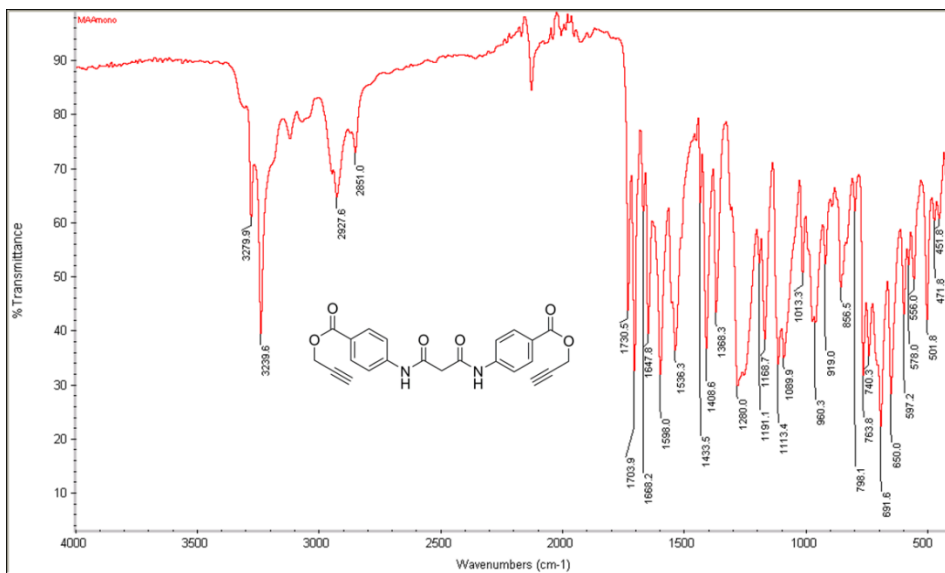
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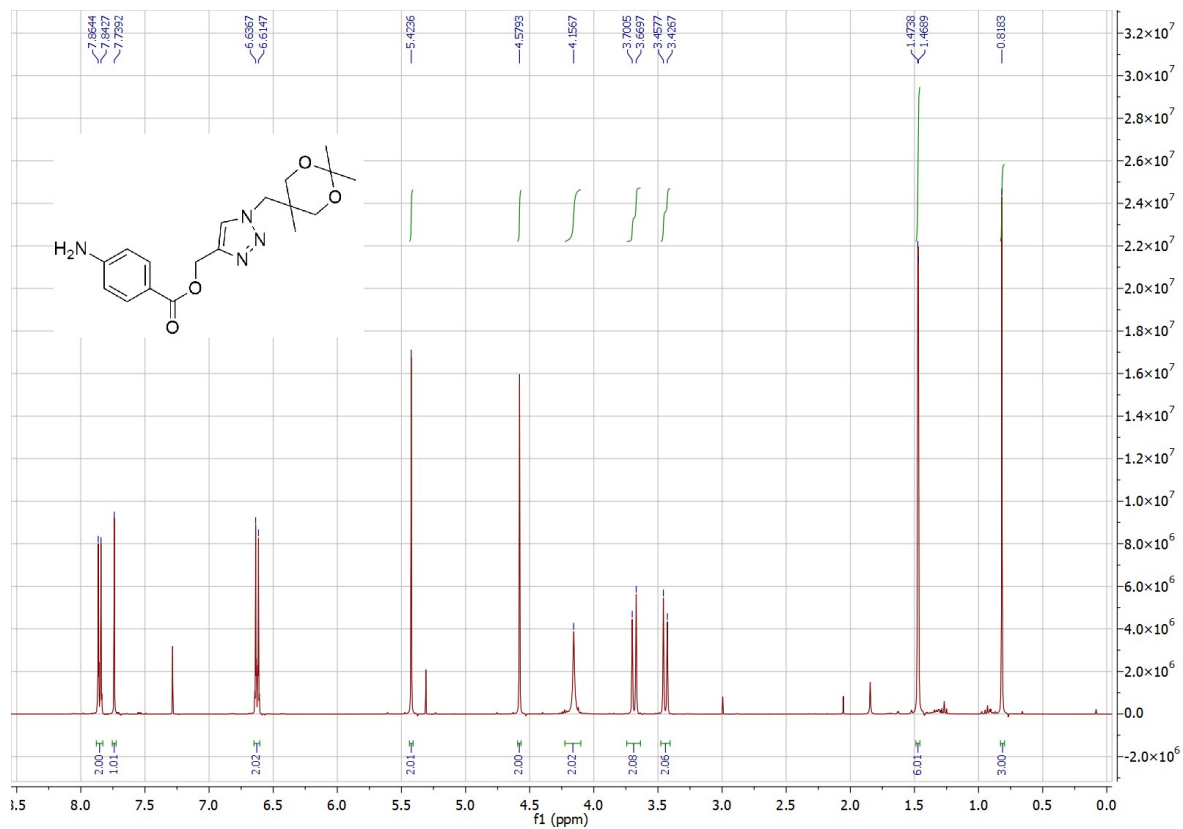
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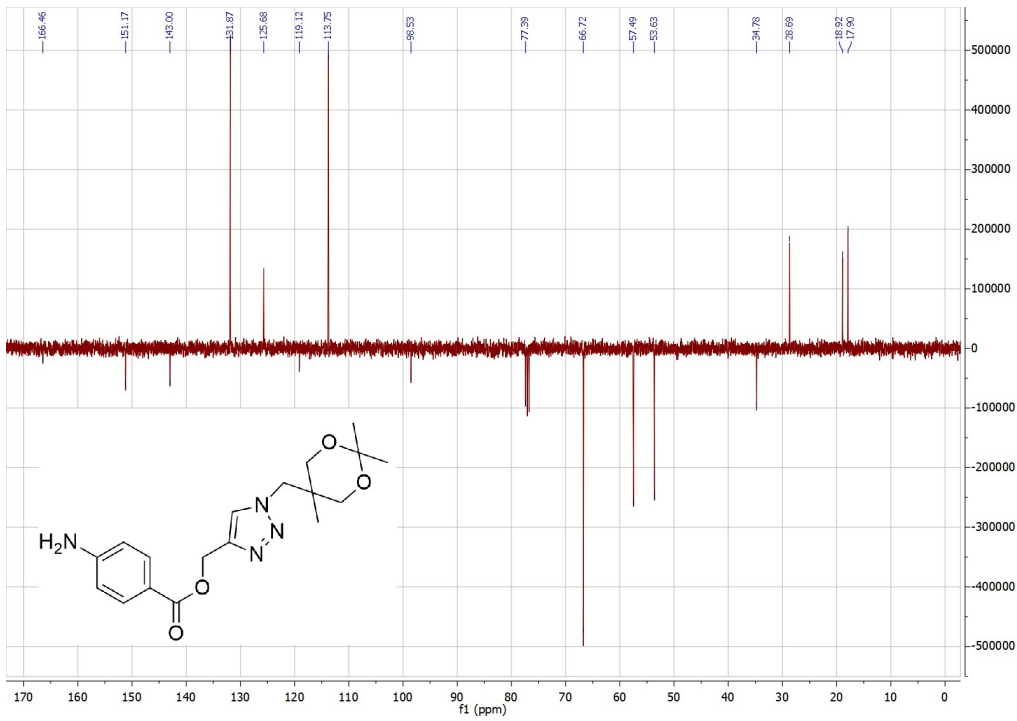
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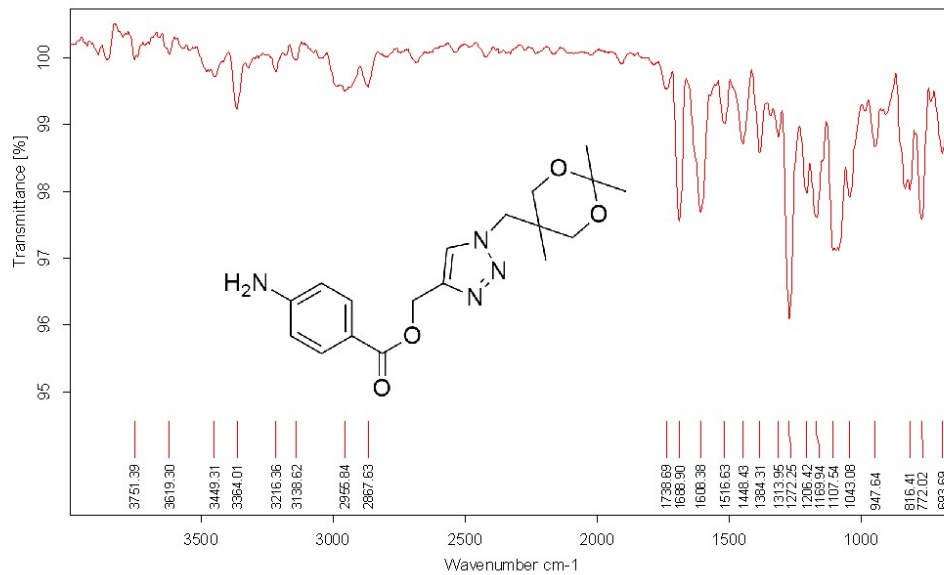
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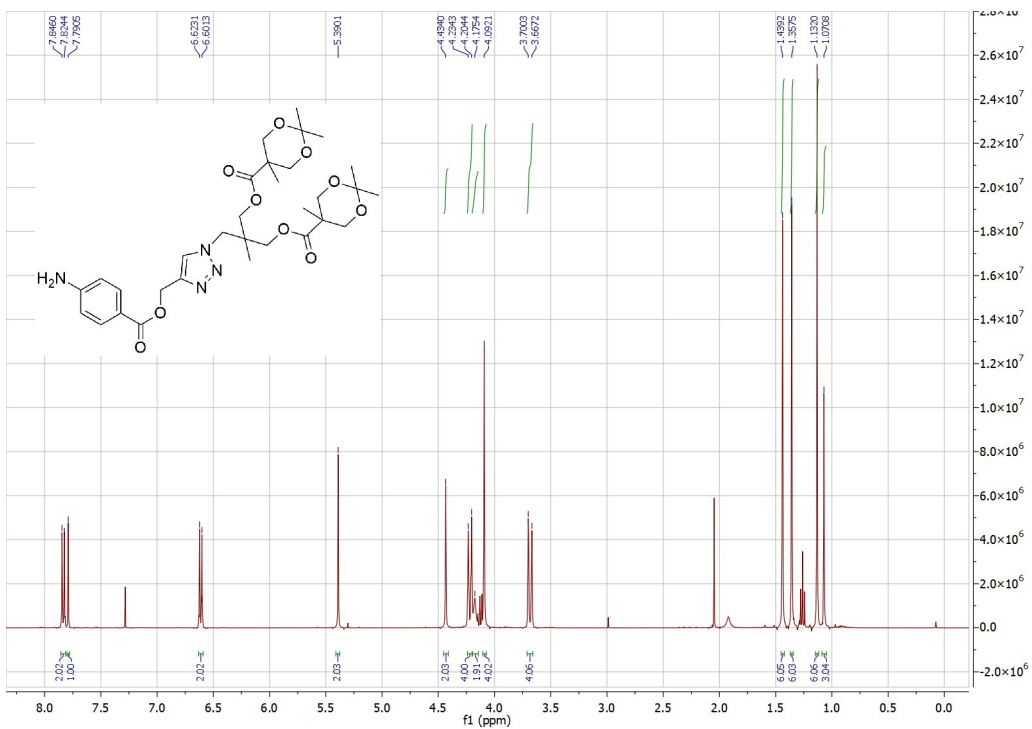


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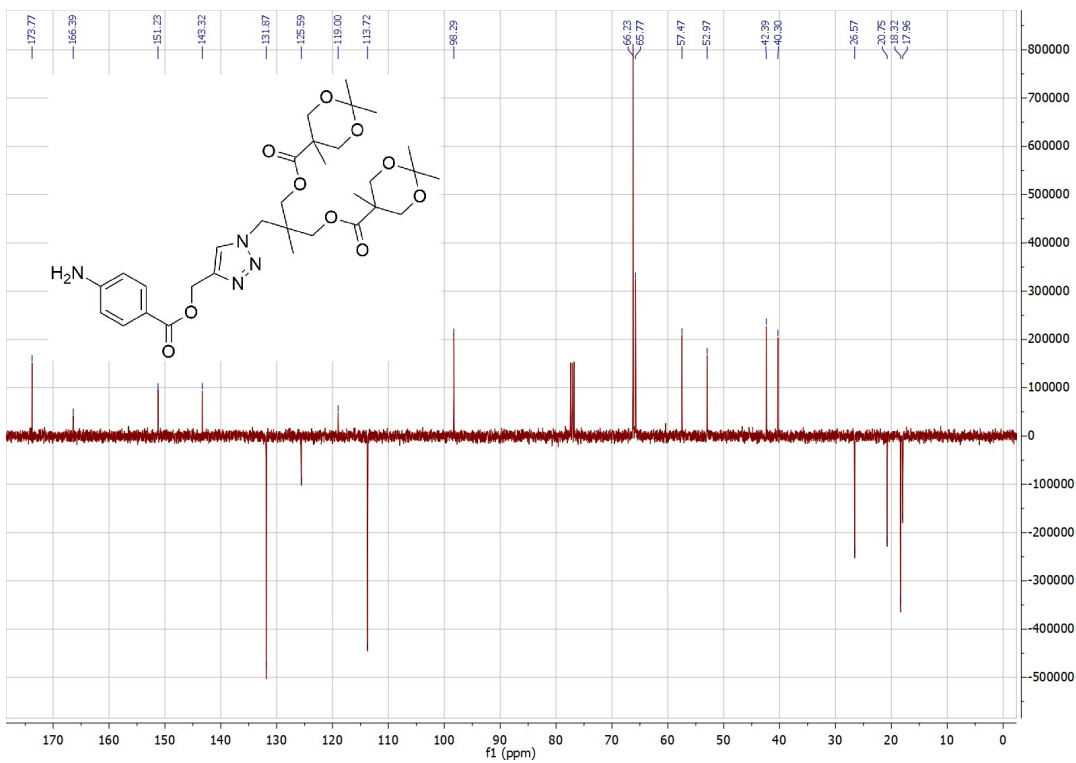


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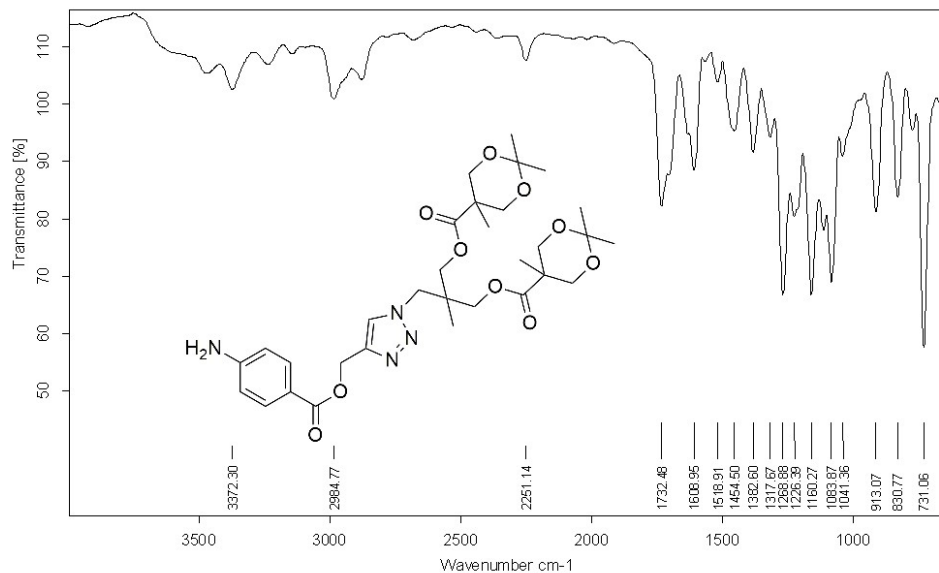
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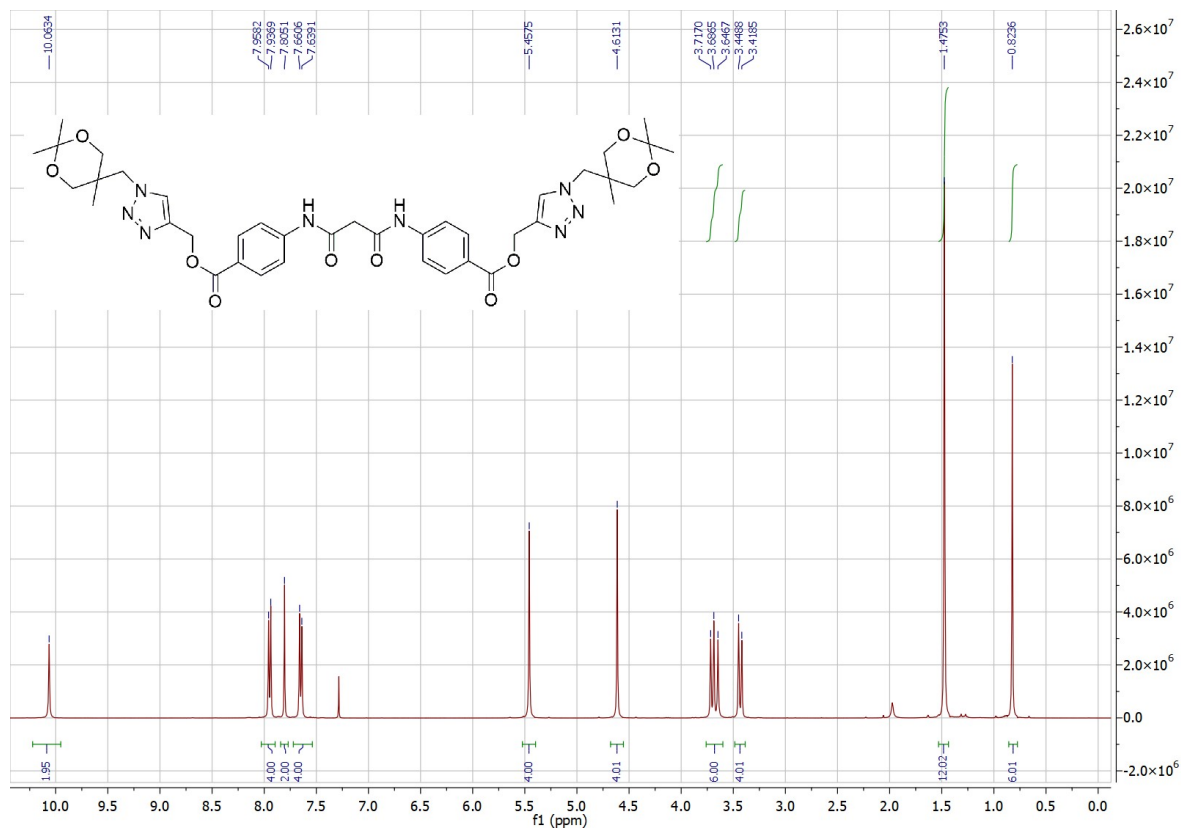


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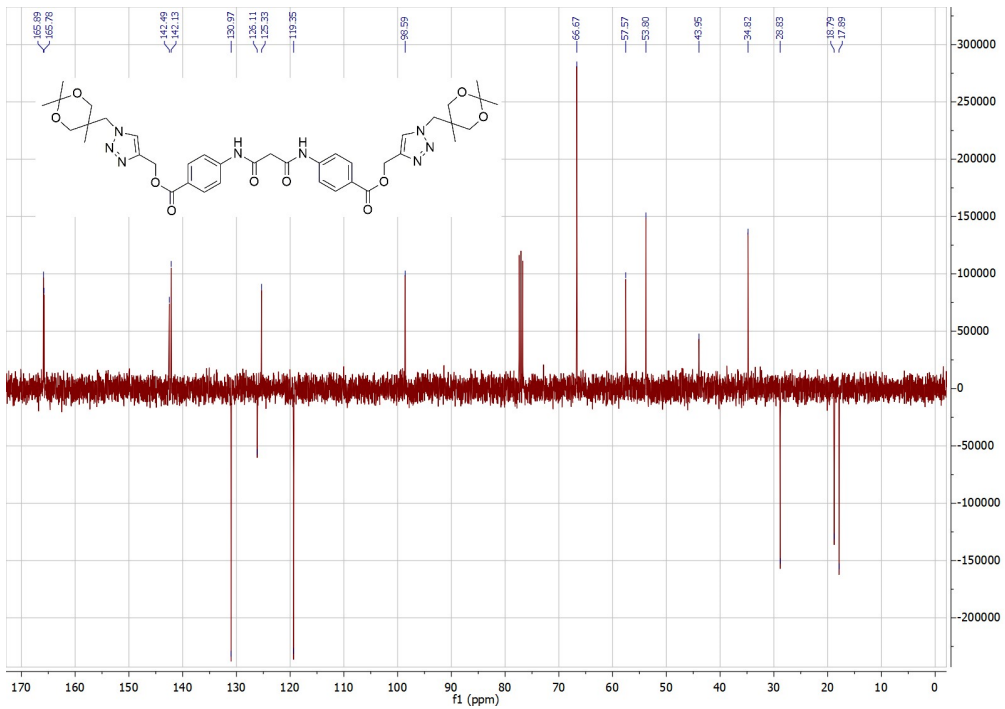


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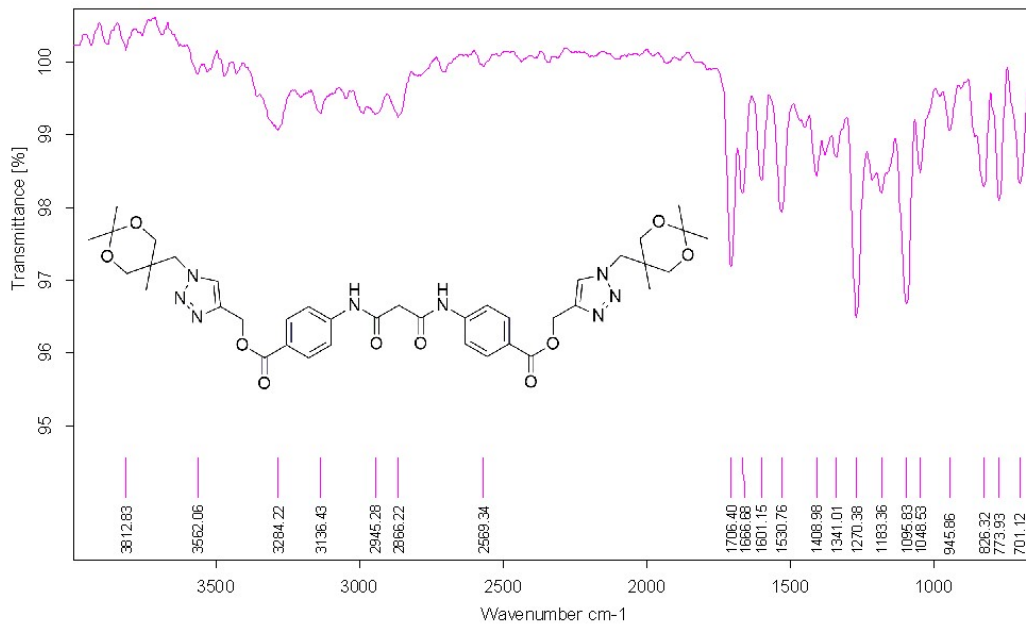
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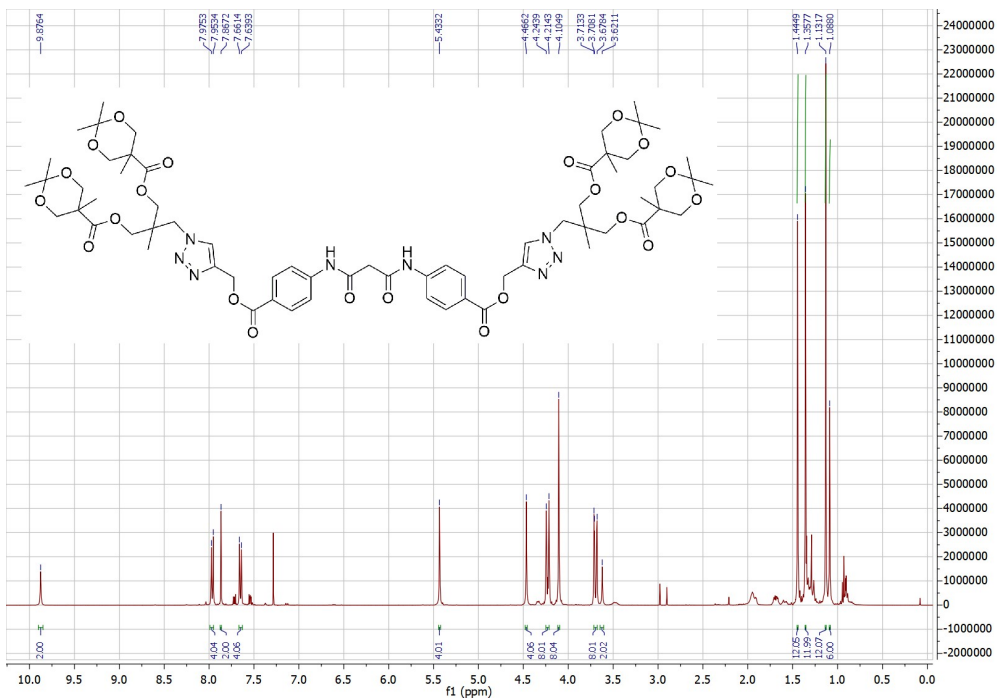


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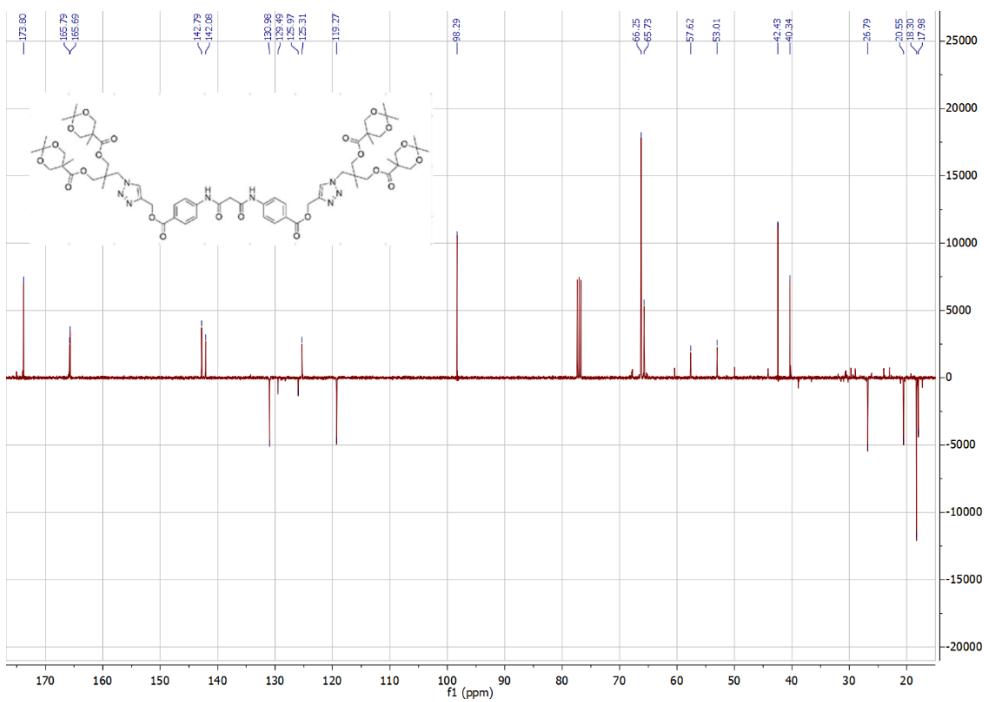


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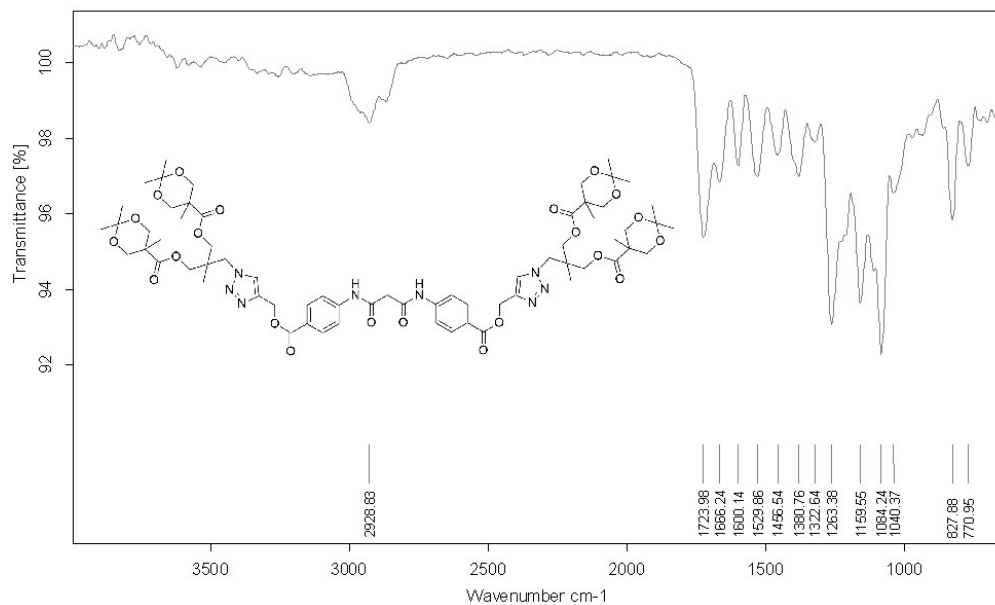
¹H- NMR of compound 20



¹³C- NMR of compound 20



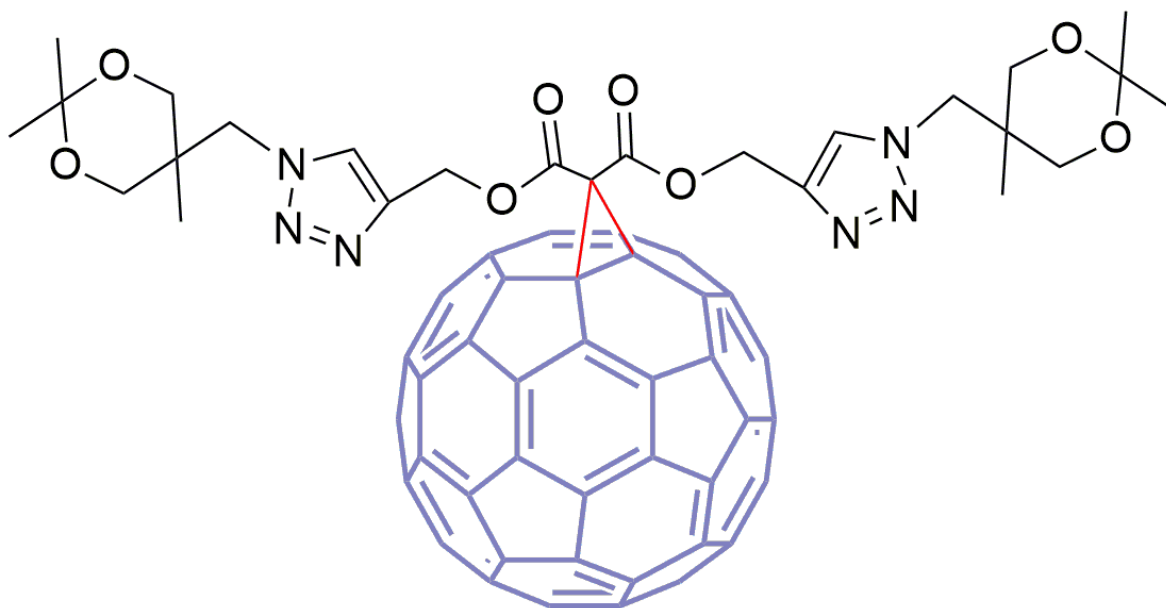
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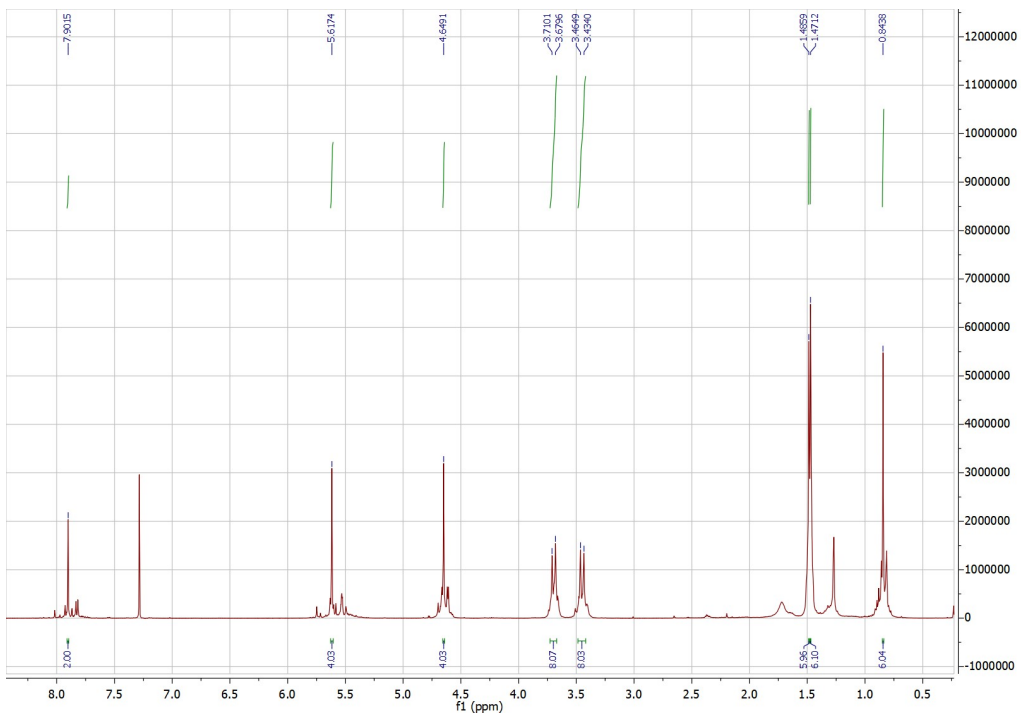
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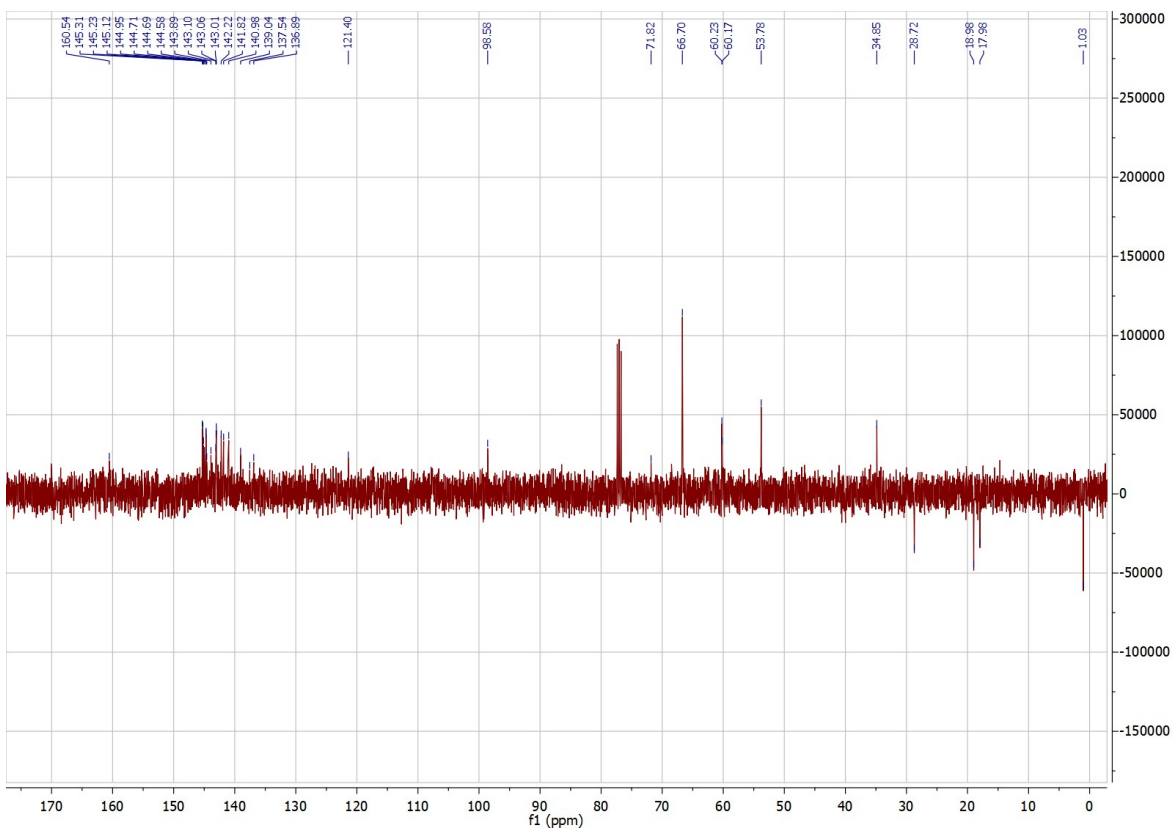
Compound 21



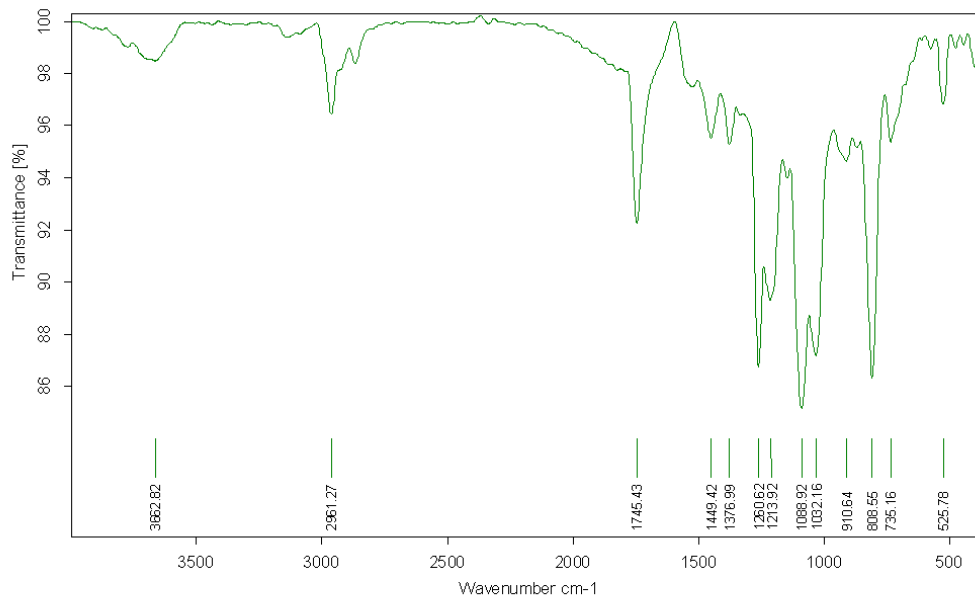
¹H- NMR of compound 21



¹³C-NMR of compound 21



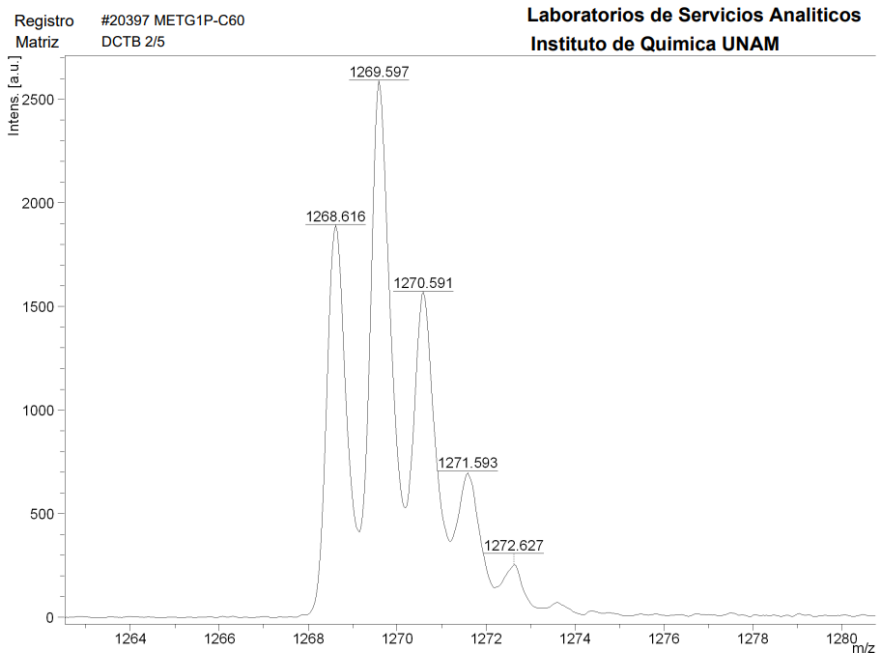
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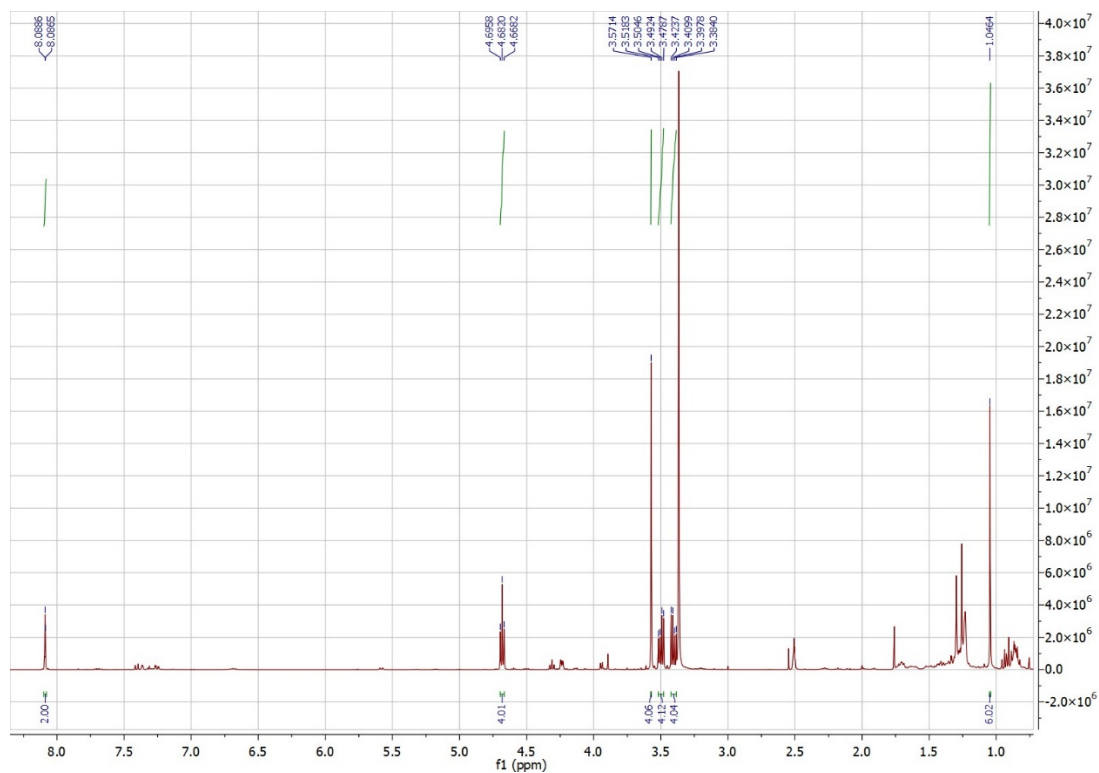
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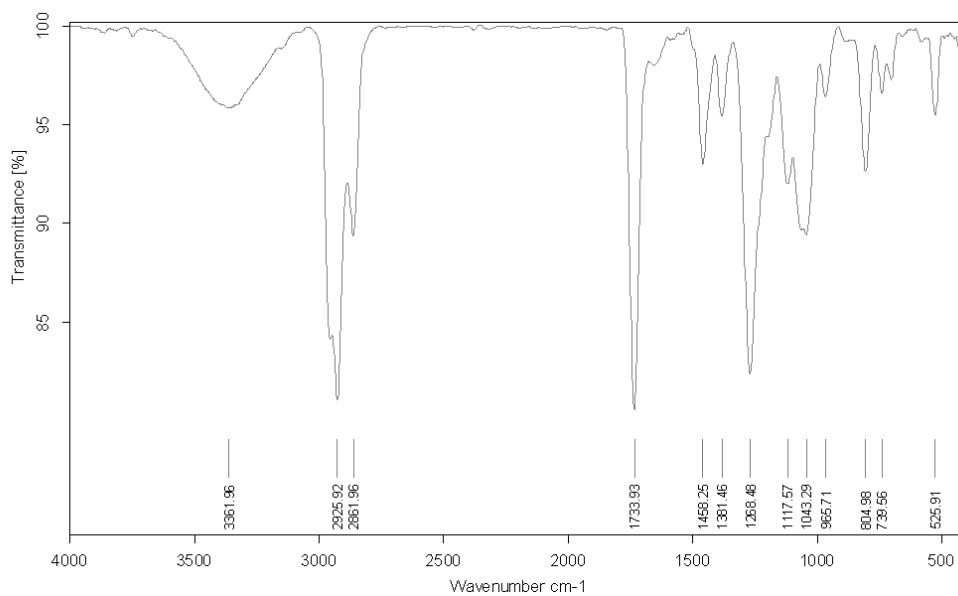
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¹H-NMR in DMSO-d6 of compound 25

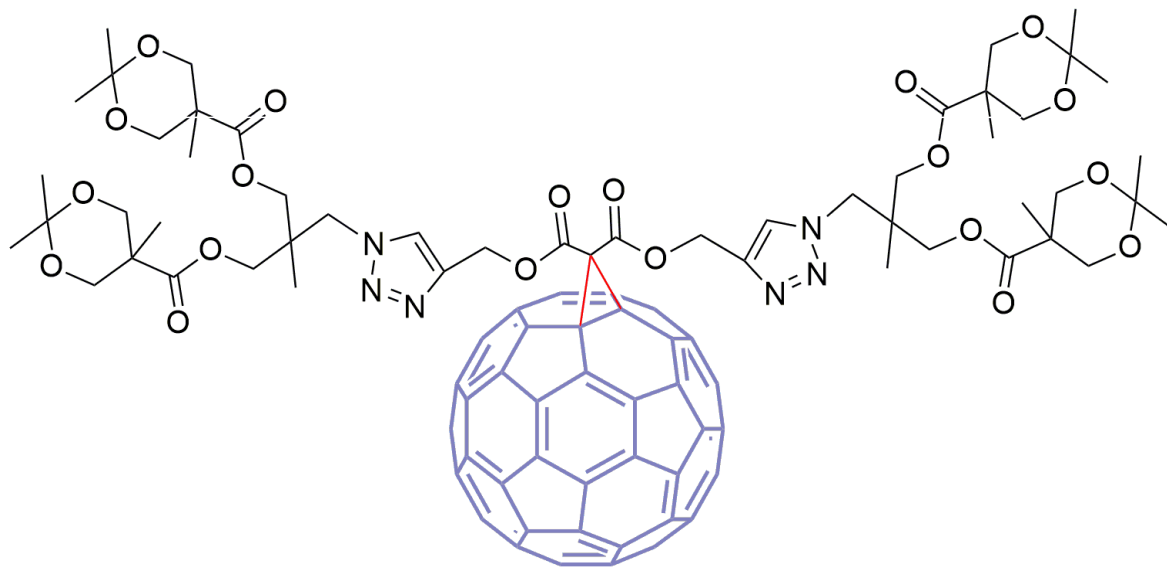


FT-IR of compound 25

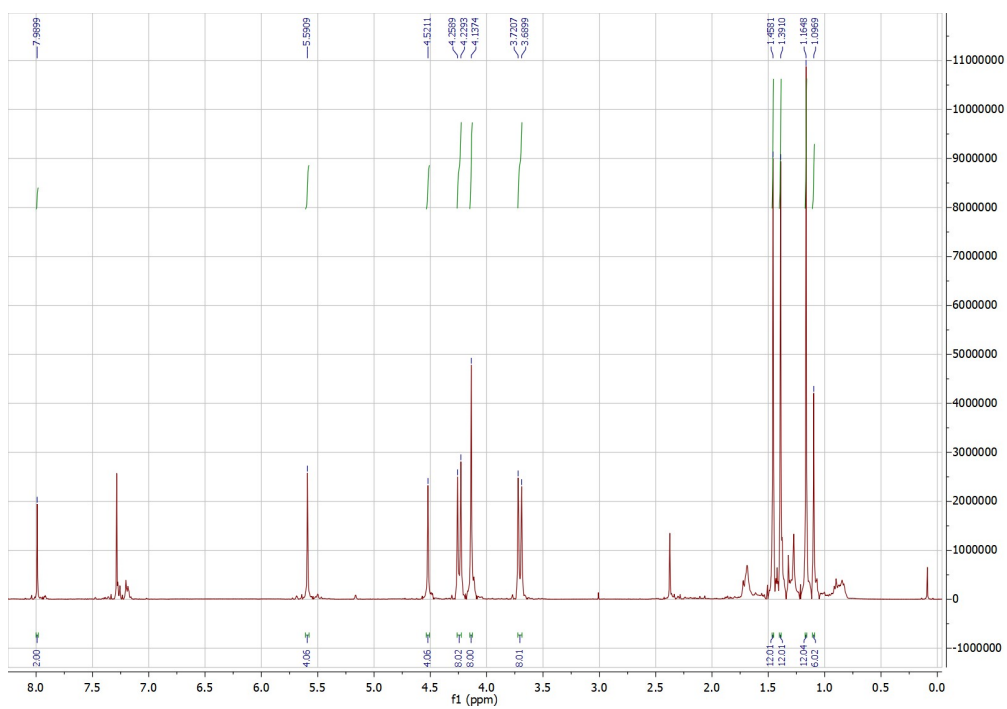


C:\Program Files\OPUS\MEAS\Melchor Martinez HICARLOS CRUZ\Sample.5 cchi Sample form 12/09/2023

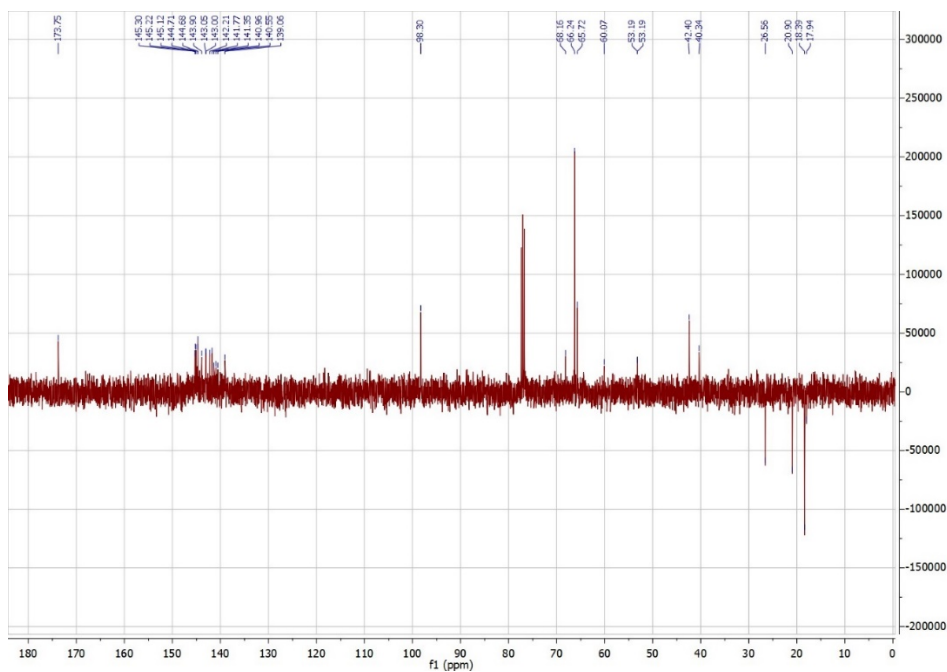
Compound 22



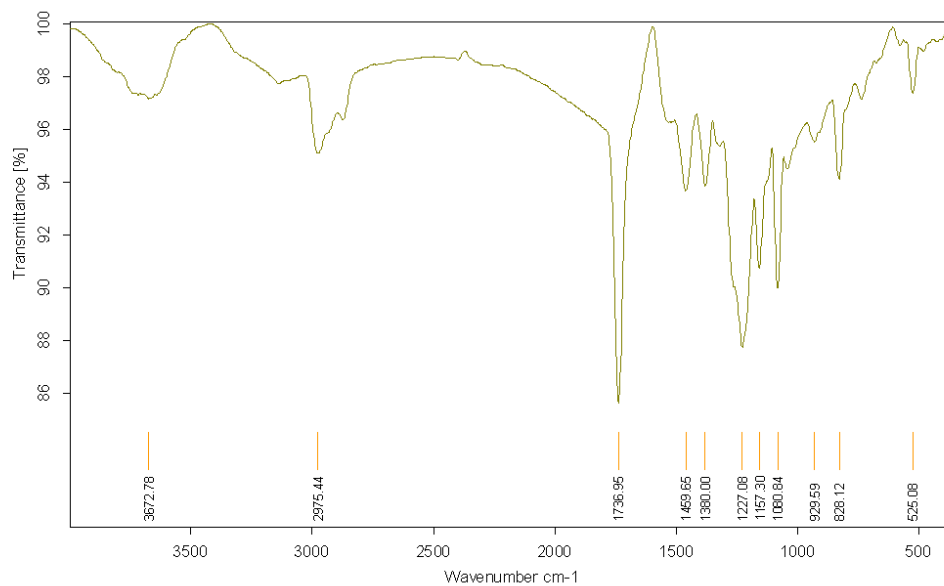
¹H-NMR of compound 22



^{13}C - NMR of compound **22**



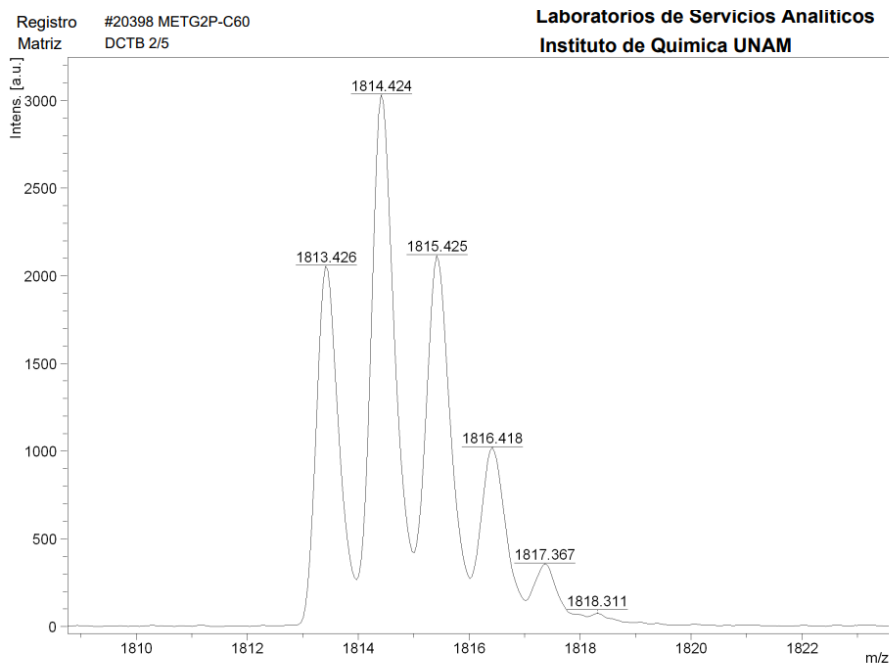
FT-IR of compound **22**



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05/09/2023

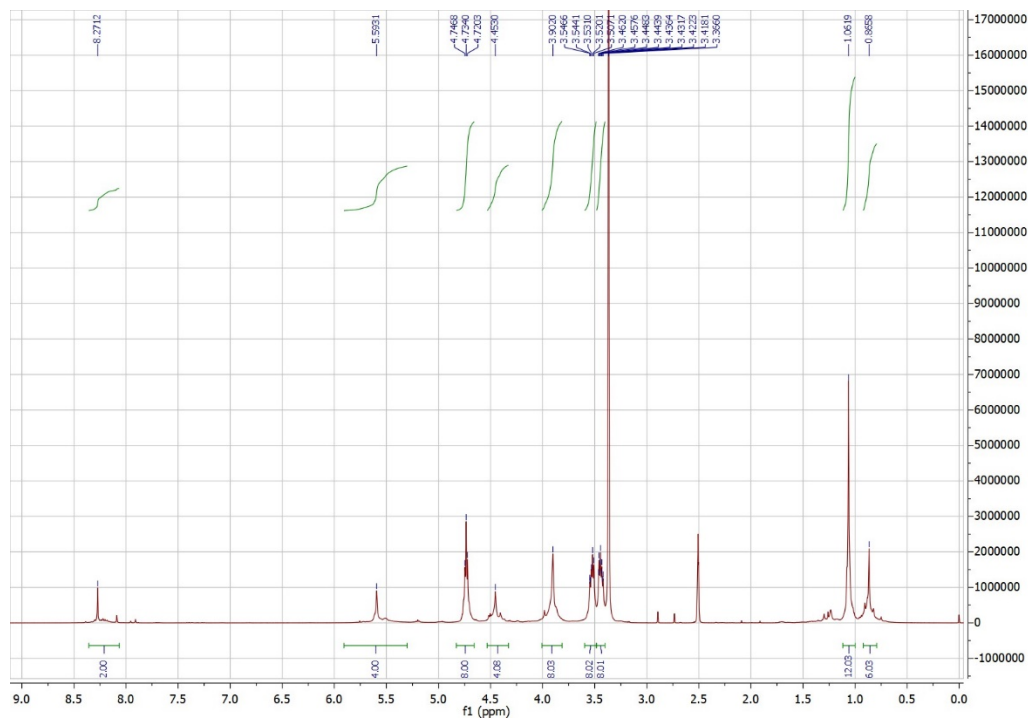
MALDI-TOF of compound 22



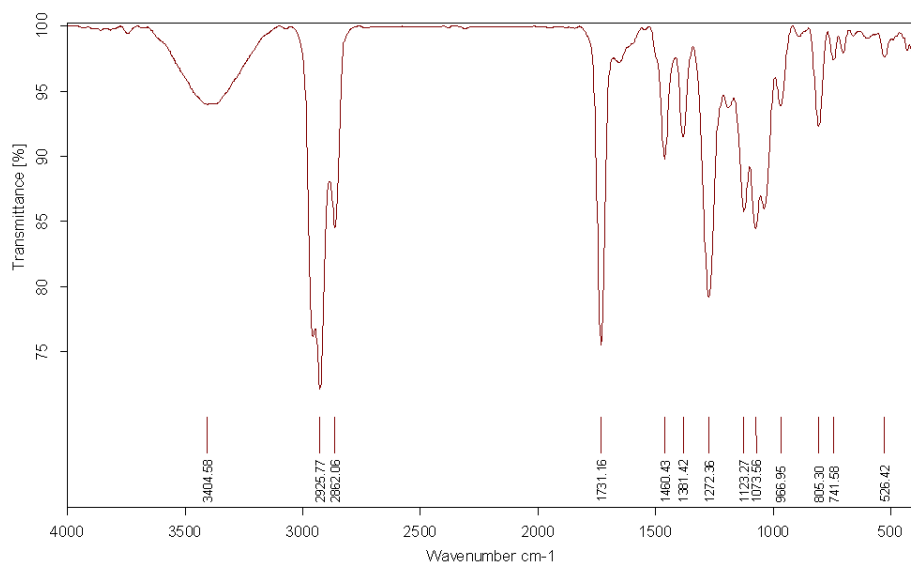
Acquisition Parameter

Date of acquisition 2023-09-11T13:25:26.531-05:00
Acquisition method name D:\Methods\flexControlMethods\LNM_UNAMRP_2465_ciclo BIEN.par
Acquisition operation mode Reflector
Voltage polarity POS

$^1\text{H-NMR}$ in DMSO- d_6 of compound 26



FT-IR of compound 26

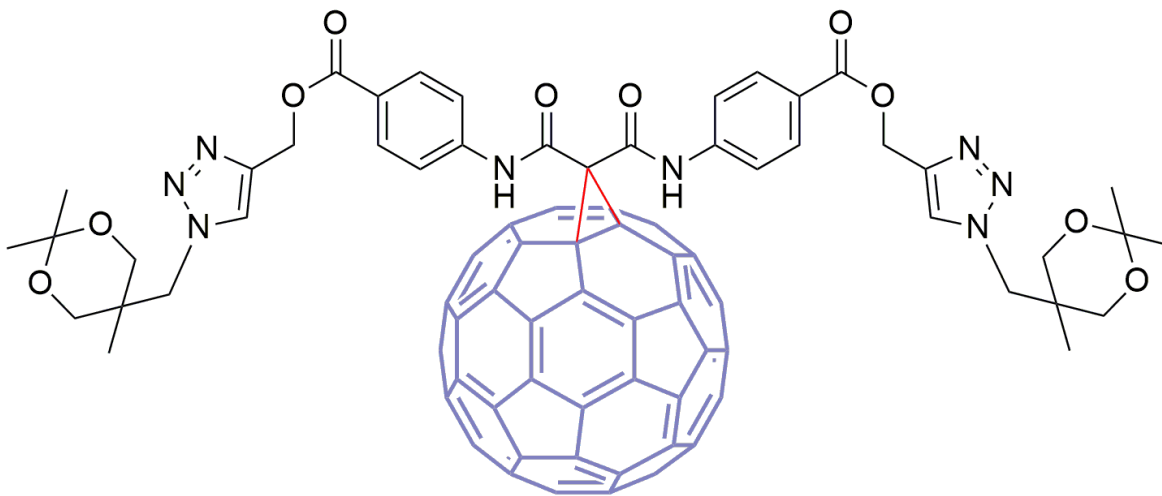


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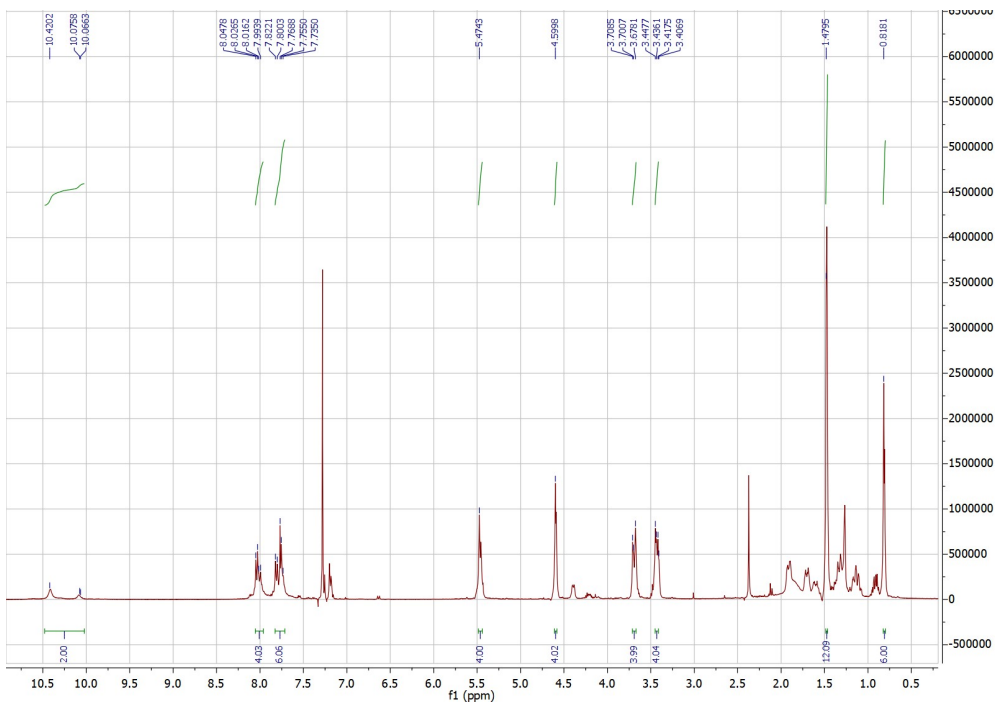
12/09/2023

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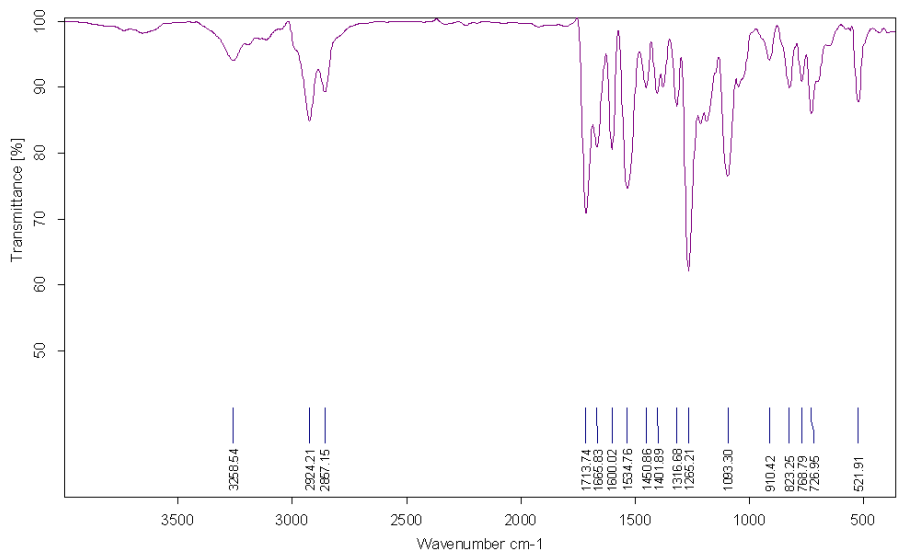
Compound 23



¹H- NMR of compound 23

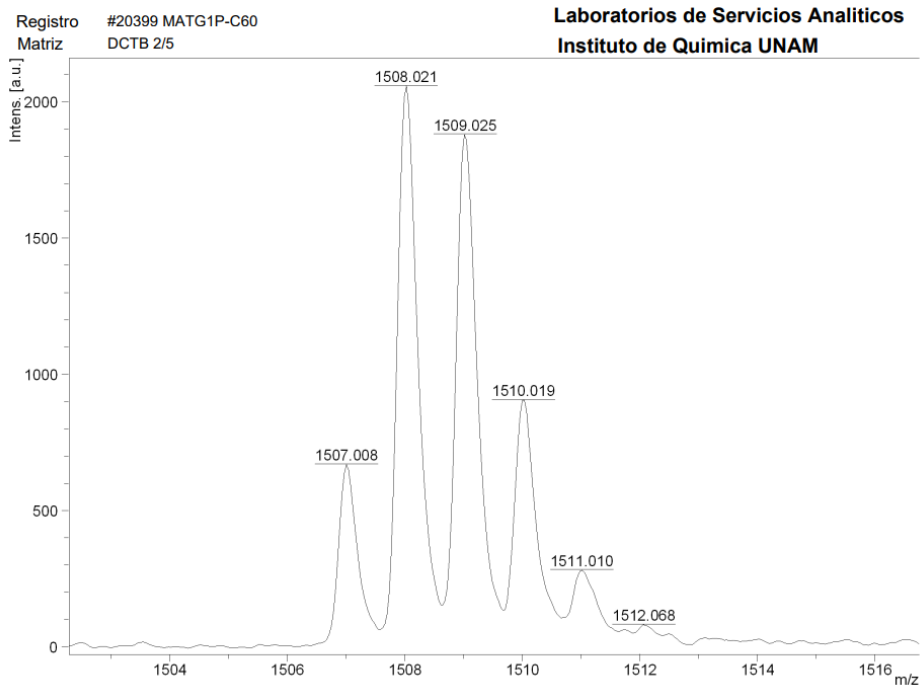


FT-IR of compound 23



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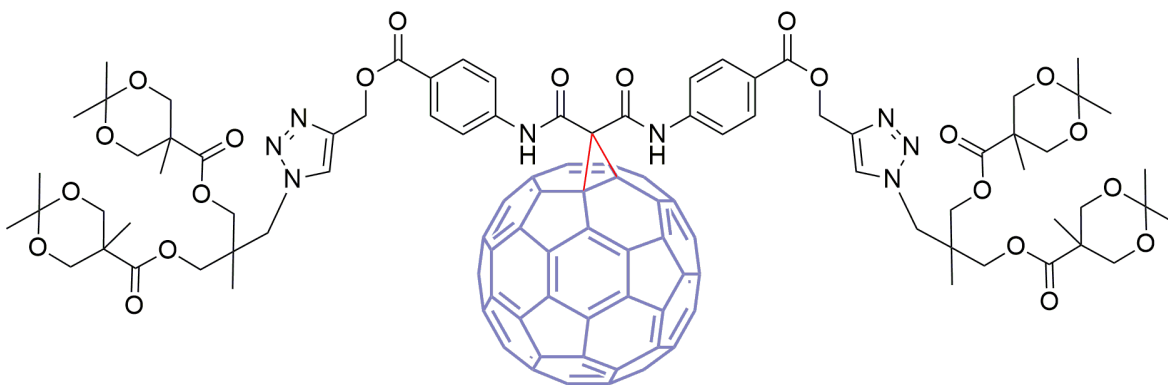
^1H - NMR of compound **23**



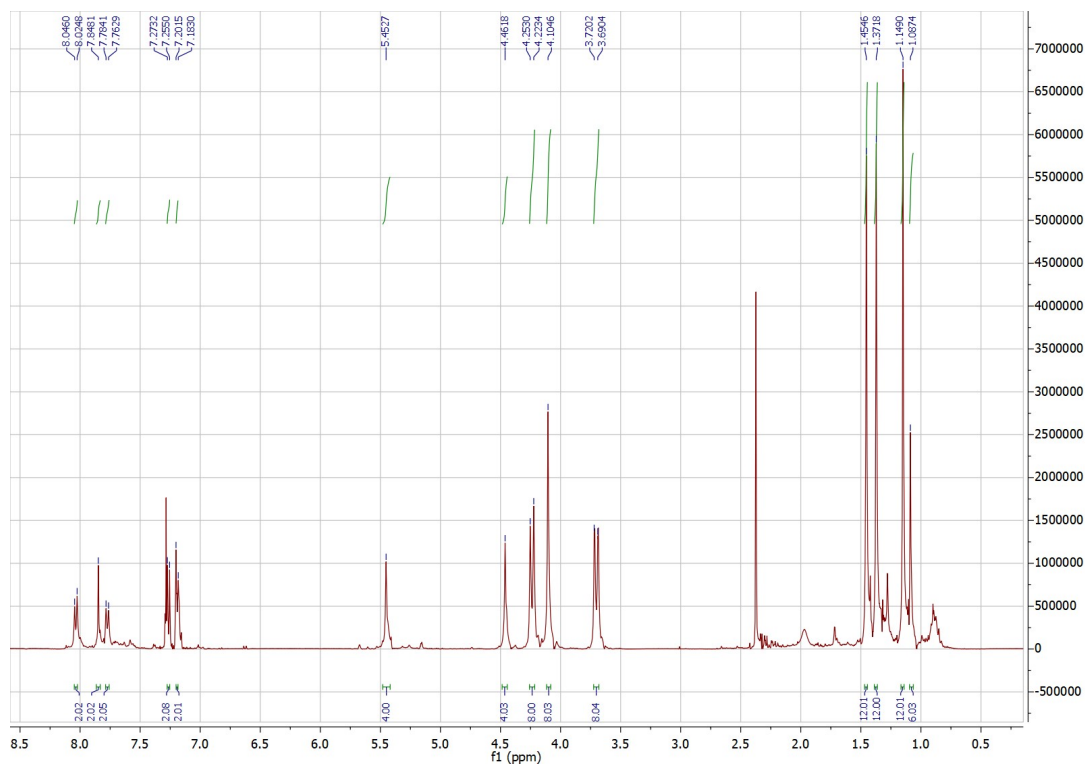
Acquisition Parameter

Date of acquisition 2023-09-11T13:42:32.359-05:00
Acquisition method name D:\Methods\flexControlMethods\LNM_UNAM\RP_2465_ciclo BIEN.par
Acquisition operation mode Reflector
Voltage polarity POS

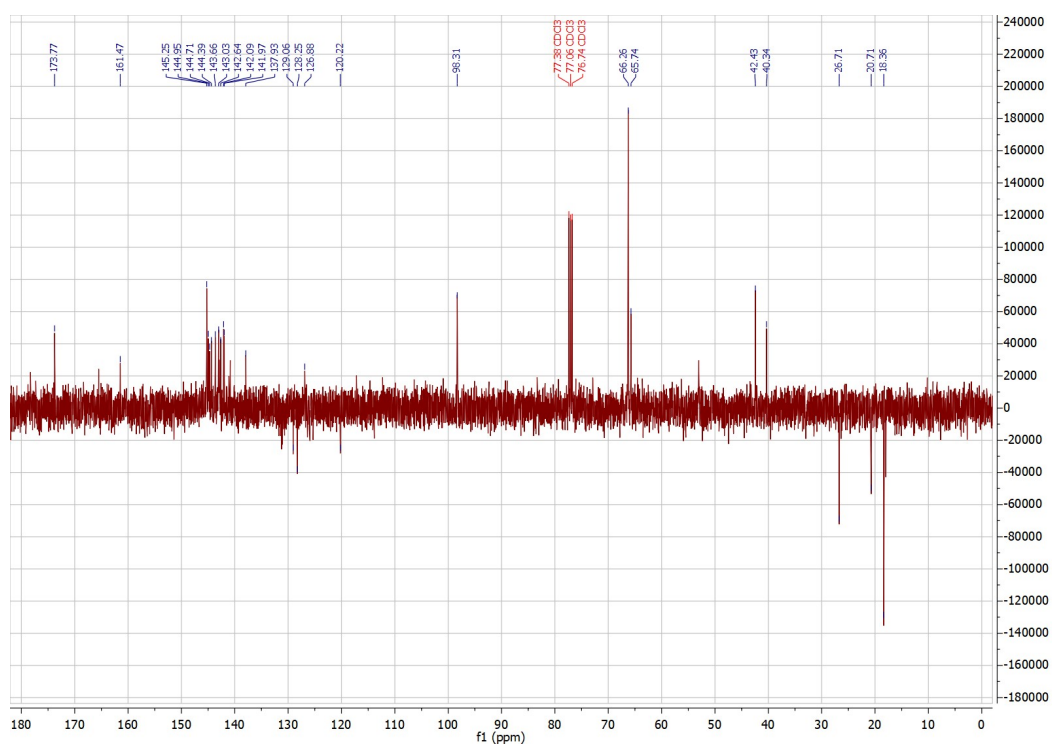
Compound **24**



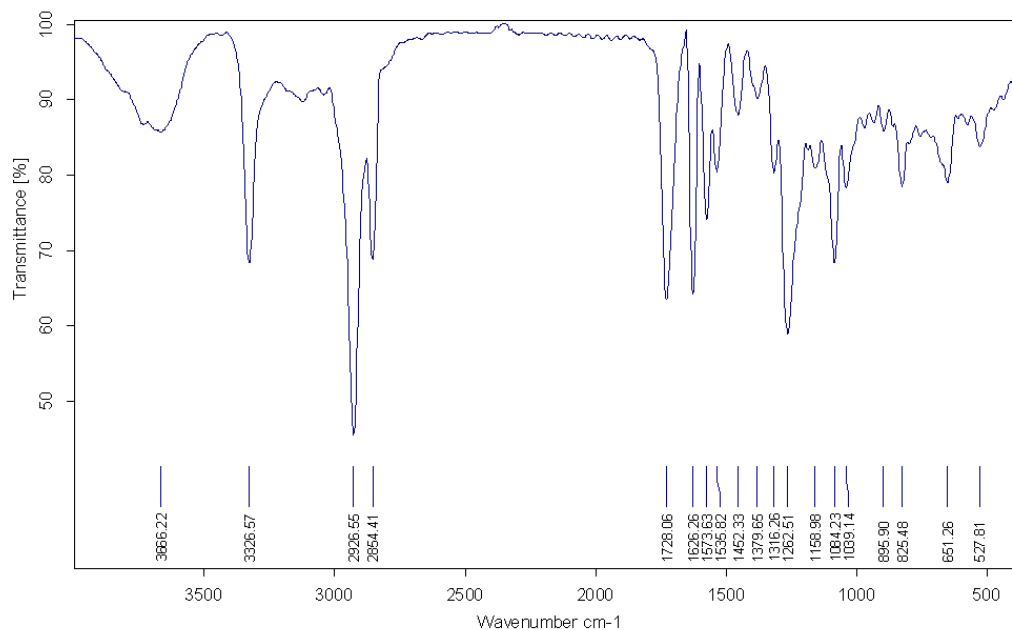
^1H - NMR of compound **24**



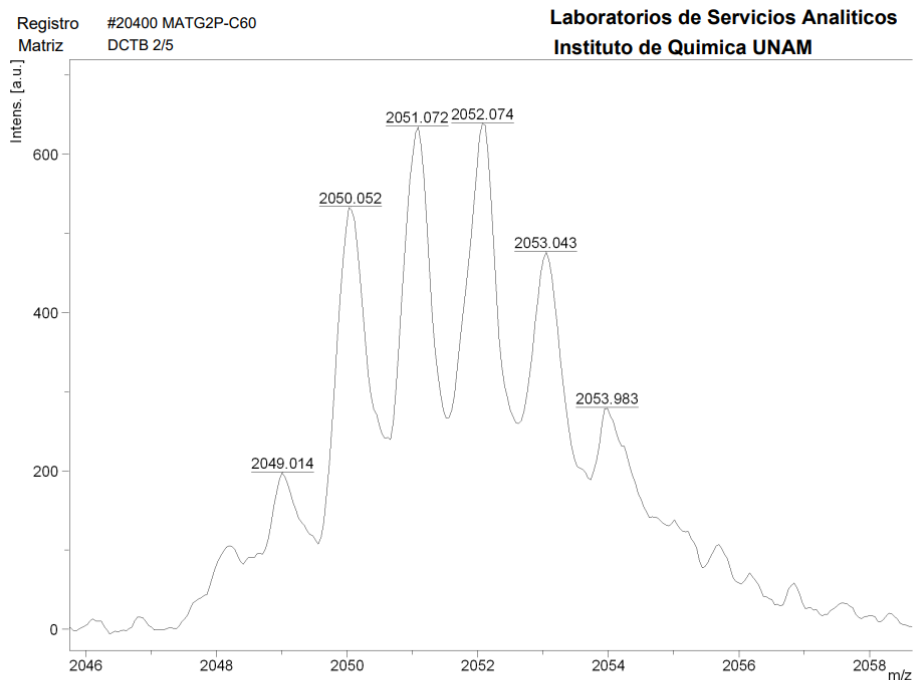
¹³C- NMR of compound 24



FT-IR of compound 24



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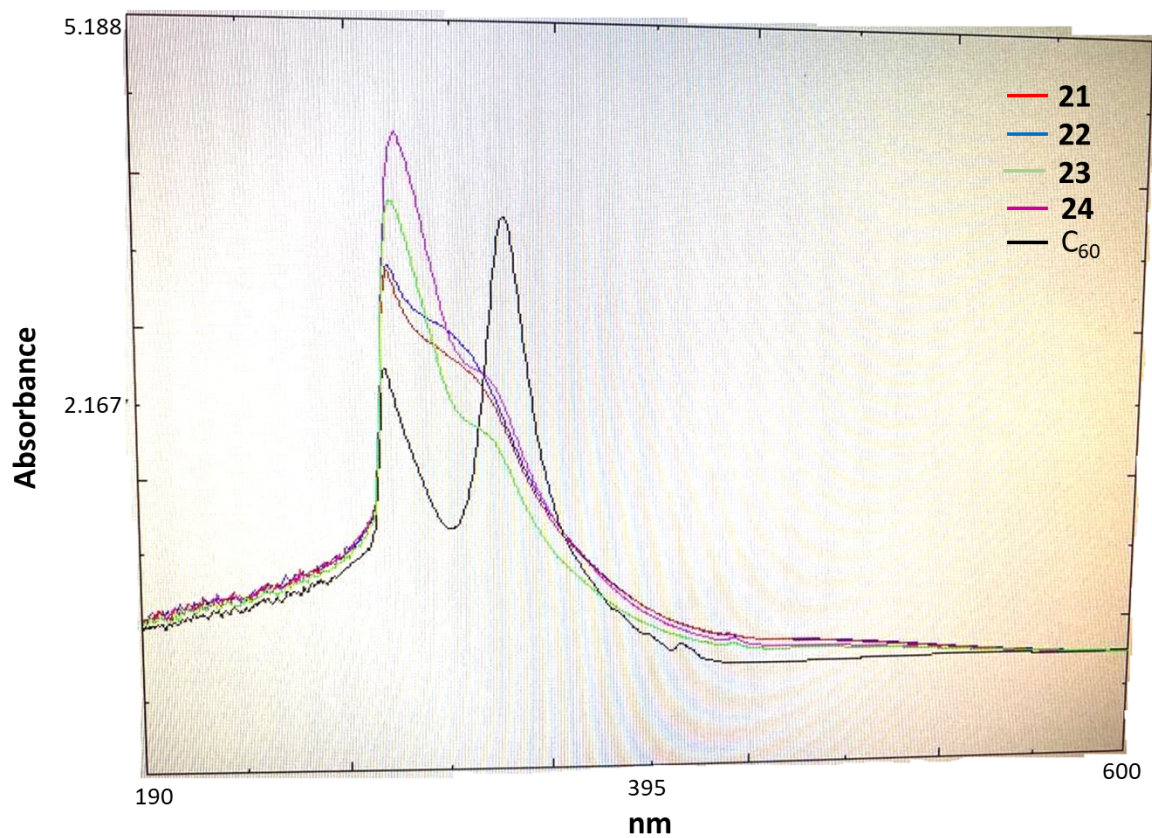


Acquisition Parameter

Date of acquisition	2023-09-11T13:46:17.750-05:00
Acquisition method name	D:\Methods\flexControlMethods\LNLM_UNAM\RP_2465_ciclo BIEN.par
Acquisition operation mode	Reflector
Voltage polarity	POS

3. UV-vis analysis of compounds **21** – **24**

Spectra were measured in 50 μM solutions in Chlorobenzene.



Compound	λ_{Max} (nm)
C ₆₀	287 and 334
21	287.5
22	288.0
23	289.5
24	291.5