

Supplementary Materials

A gram scale synthesis of 3,4-dihalogen substituted 1,8-naphthalimides

Denitsa Anastasova¹, Monika Mutovska¹, Natali Simeonova¹, Irena Zagransyarska², Zlatina Vlahova³, Stanimir Stoyanov¹, and Yulian Zagransyarski^{1*}

¹ Faculty of Chemistry and Pharmacy, Sofia University "St. Kliment Ohridski", 1164 Sofia, Bulgaria

² Institute of Organic Chemistry with Centre of Phytochemistry, Bulgarian Academy of Sciences, Acad. G. Bonchev 9, 1113 Sofia, Bulgaria

³ Institute of Molecular Biology "Acad. Roumen Tsanev", Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bld. 21, 1113 Sofia, Bulgaria

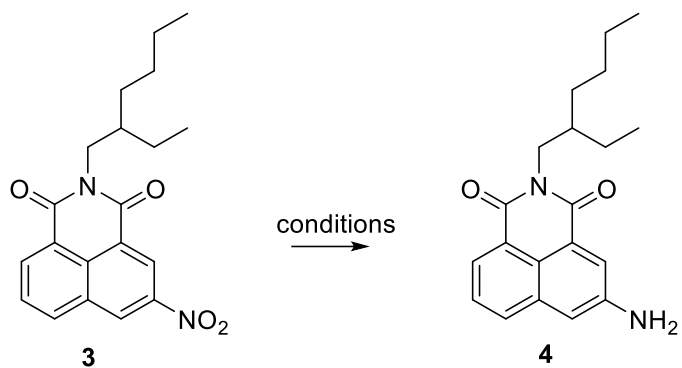
* Correspondence: ohjz@chem.uni-sofia.bg

Contents

Optimization of the reaction conditions for reduction of 3	3
Figure S1: ¹ H NMR spectrum of the compound 3	4
Figure S2: ¹³ C NMR spectrum of the compound 3	4
Figure S3: ¹ H NMR spectrum of the compound 4	5
Figure S4: ¹³ C NMR spectrum of the compound 4	5
Figure S5: ¹ H NMR spectrum of the compound 5	6
Figure S6: ¹³ C NMR spectrum of the compound 5	6
Figure S7: ¹ H NMR spectrum of the compound 6	7
Figure S8: ¹³ C NMR spectrum of the compound 6	7
Figure S9: ¹ H NMR spectrum of the compound 7	8
Figure S10: ¹³ C NMR spectrum of the compound 7	8
Figure S11: ¹ H NMR spectrum of the compound 8	9
Figure S12: ¹³ C NMR spectrum of the compound 8	9
Figure S13: ¹ H NMR spectrum of the compound 9	10
Figure S14: ¹³ C NMR spectrum of the compound 9	10
Figure S15: ¹ H NMR spectrum of the compound 10	11

Figure S16: ^{13}C NMR spectrum of the compound 10	11
Figure S17. FT-IR spectrum and normalized absorption of the main bands of 3	12
Figure S18. FT-IR spectrum and normalized absorption of the main bands of 4	13
Figure S19. FT-IR spectrum and normalized absorption of the main bands of 5	14
Figure S20. FT-IR spectrum and normalized absorption of the main bands of 6	15
Figure S21. FT-IR spectrum and normalized absorption of the main bands of 7	16
Figure S22. FT-IR spectrum and normalized absorption of the main bands of 8	17
Figure S23. FT-IR spectrum and normalized absorption of the main bands of 9	18
Figure S24. FT-IR spectrum and normalized absorption of the main bands of 10	19
Figure S25: HRMS spectrum of compound 4	20
Figure S26: HRMS spectrum of compound 5	20
Figure S27: HRMS spectrum of compound 6	21
Figure S28: HRMS spectrum of compound 7	21
Figure S29: HRMS spectrum of compound 8	22
Figure S30: HRMS spectrum of compound 9	22
Figure S31: HRMS spectrum of compound 10	23

Optimization of the reaction conditions for reduction of **3**



Entry	Conditions ^a	Yield of amine 4 , % ^b	Side products
1	H ₂ 1 atm, Pd/C, THF, RT, 10 h	55	-
2	H ₂ NNH ₂ , Pd/C, THF, reflux, 6 h	23	hydrazo-substitution
3	SnCl ₂ , HCl, ethanol, reflux, 3 h	82	-
4	Fe powder, acetic acid, 90°C, 3 h	92	7%, <i>N</i> -acetyl
5	Fe powder, HCl, dioxane, 90°C, 4 h	77	-

^a All reactions were carried out in 5 mmol scale

^b Yield after column chromatography

Figure S1: ^1H NMR spectrum of the compound **3**

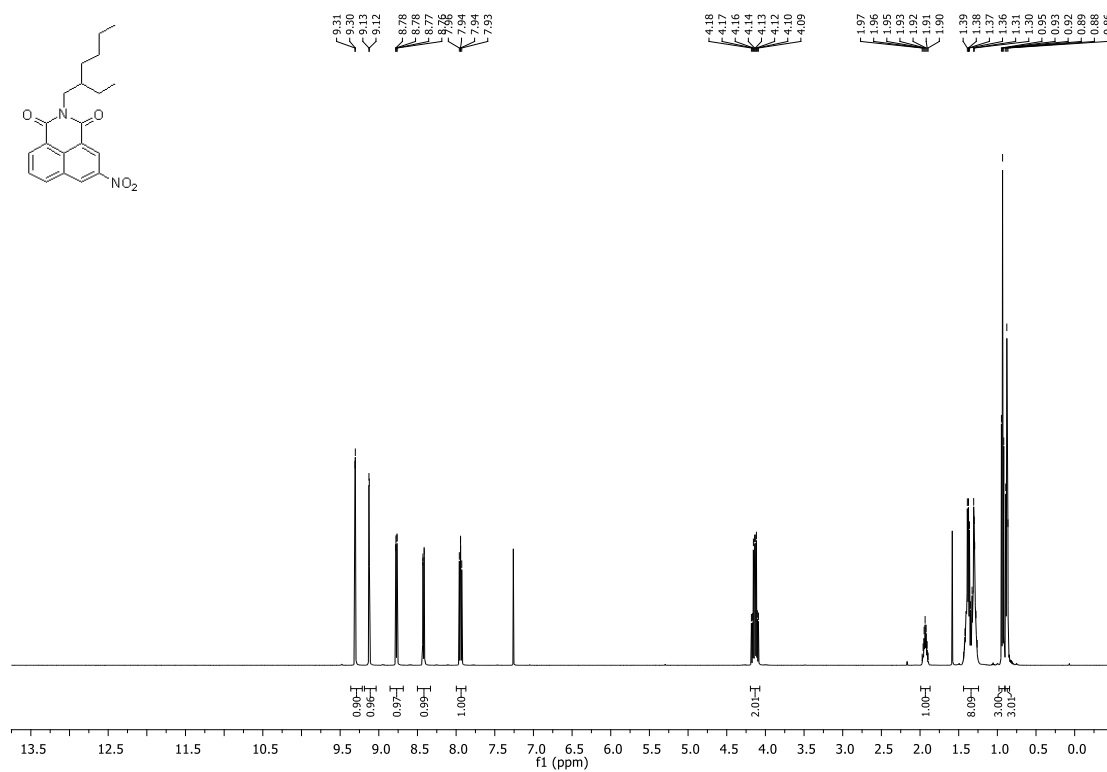


Figure S2: ^{13}C NMR spectrum of the compound **3**

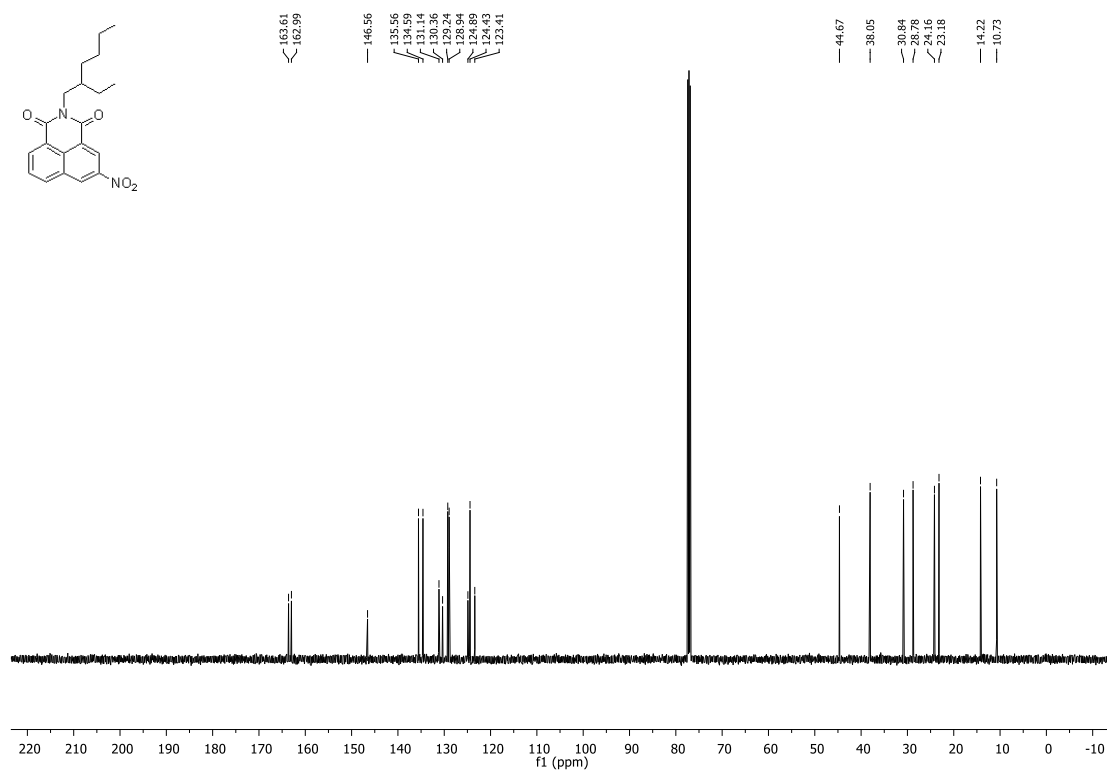


Figure S3: ^1H NMR spectrum of the compound **4**

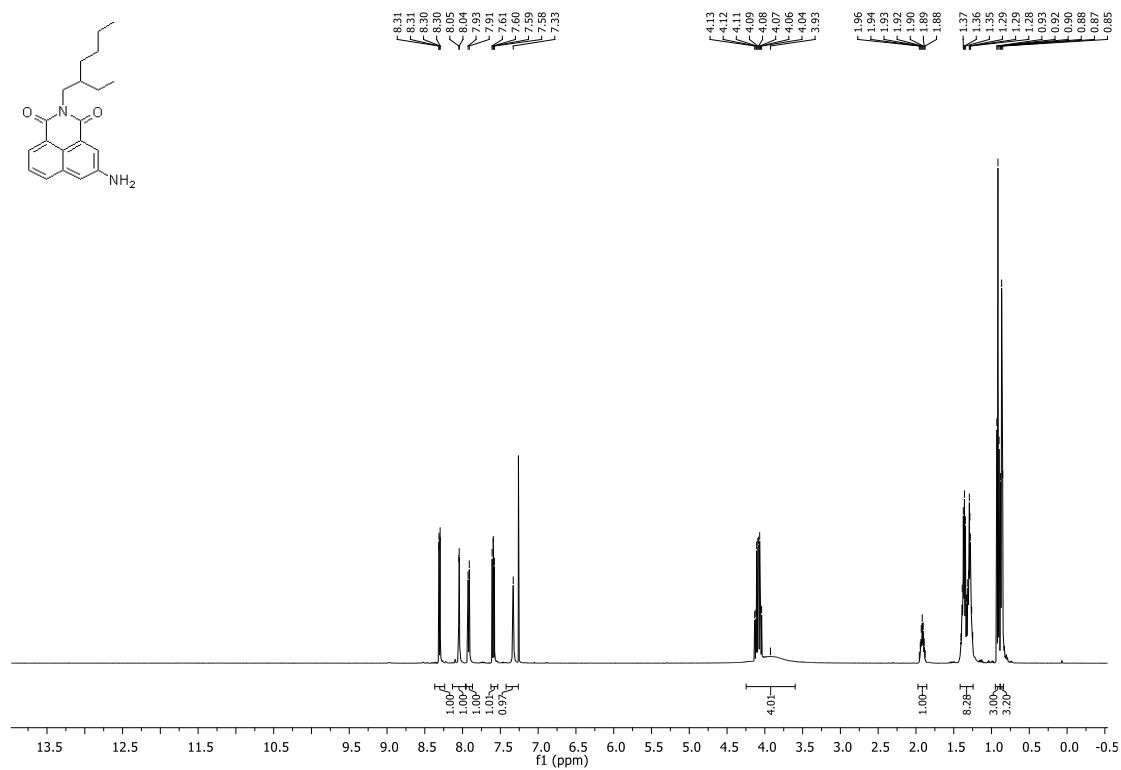


Figure S4: ^{13}C NMR spectrum of the compound **4**

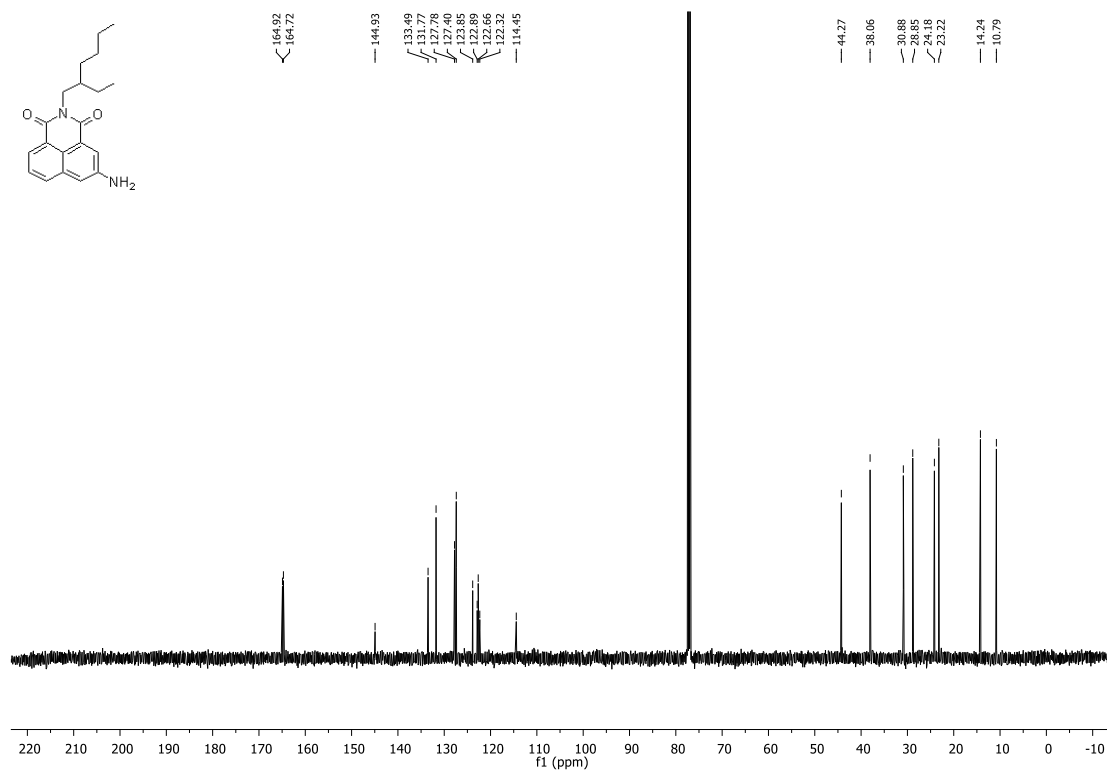


Figure S5: ¹H NMR spectrum of the compound **5**

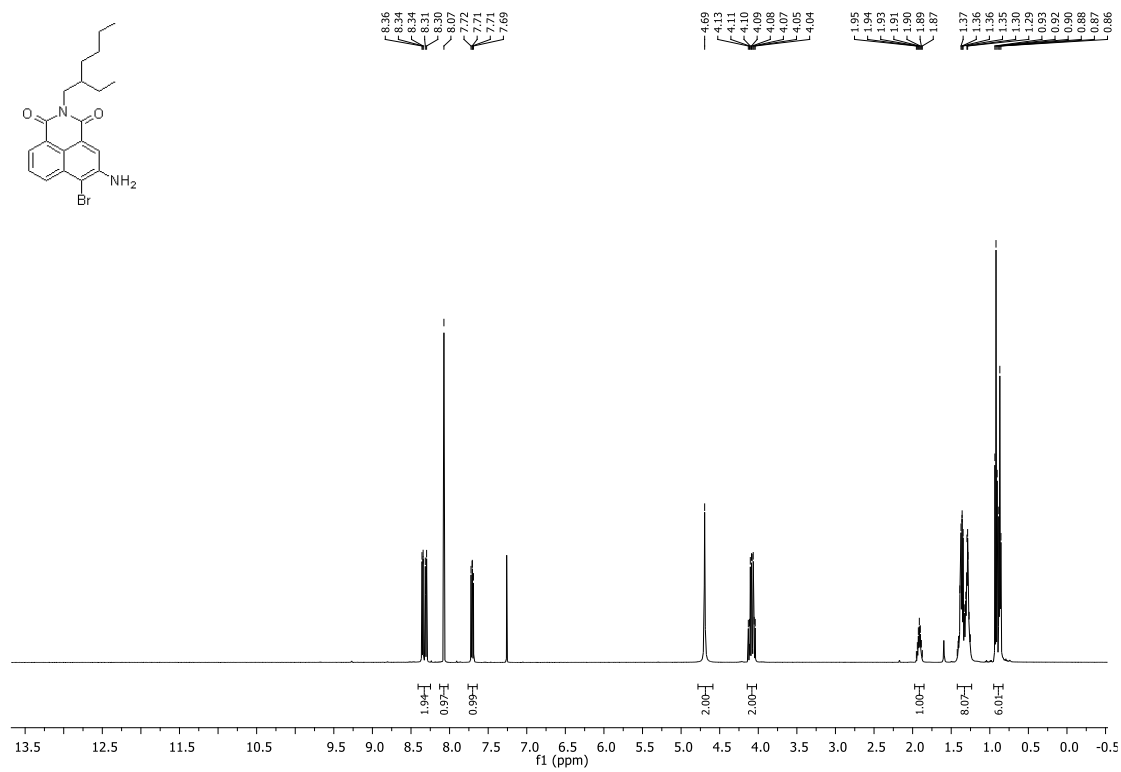


Figure S6: ¹³C NMR spectrum of the compound **5**

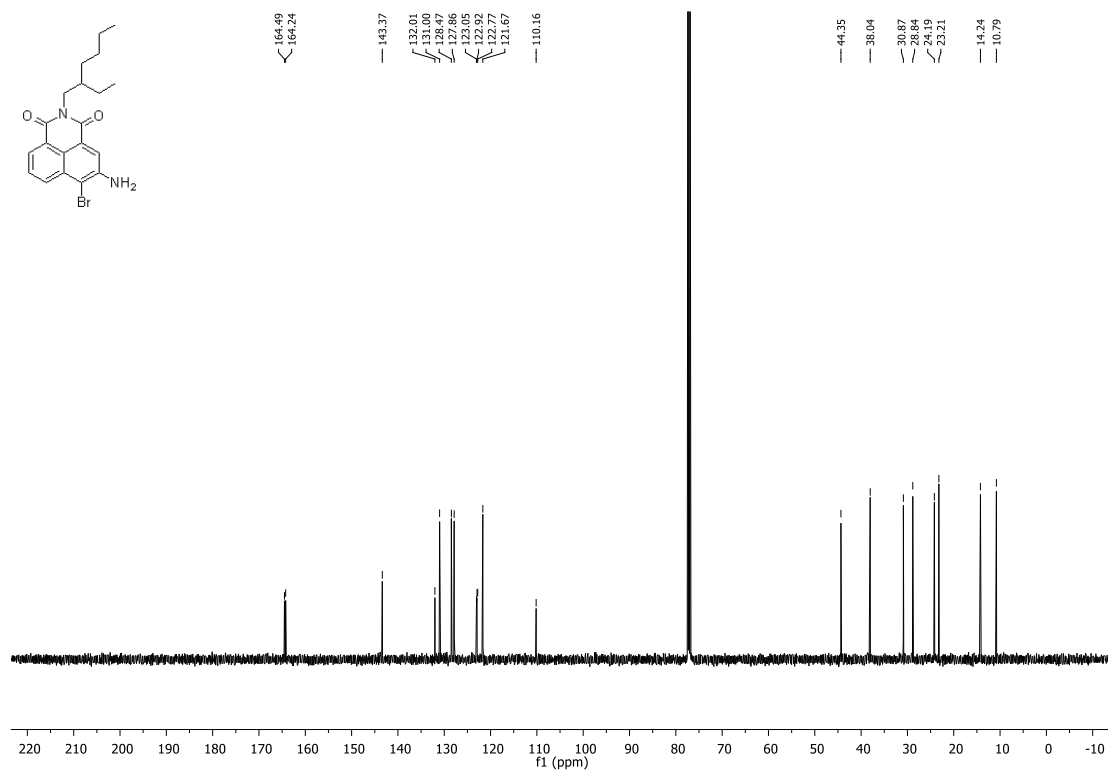


Figure S7: ^1H NMR spectrum of the compound **6**

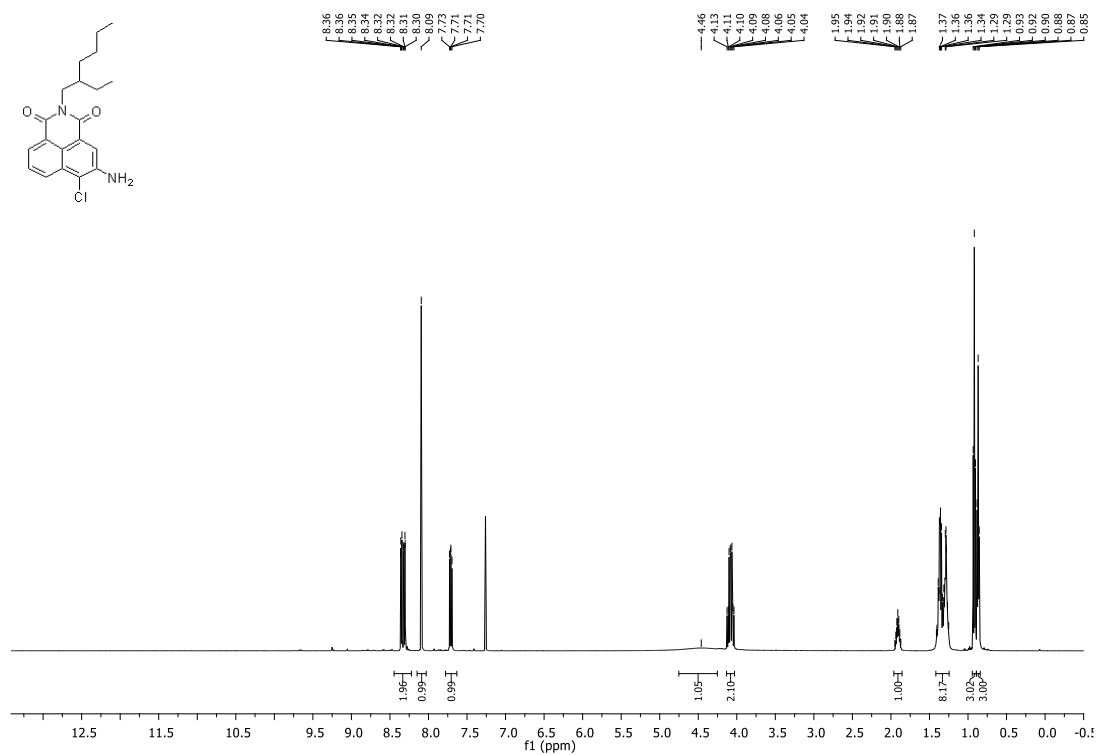


Figure S8: ^{13}C NMR spectrum of the compound **6**

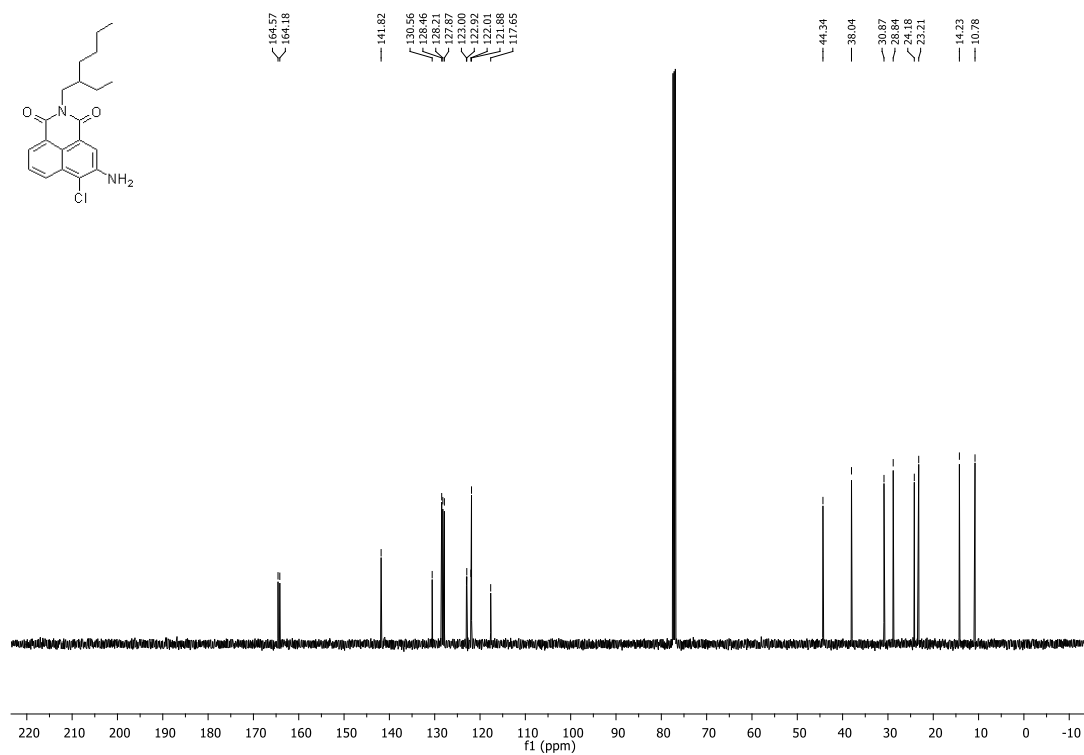


Figure S9: ^1H NMR spectrum of the compound **7**

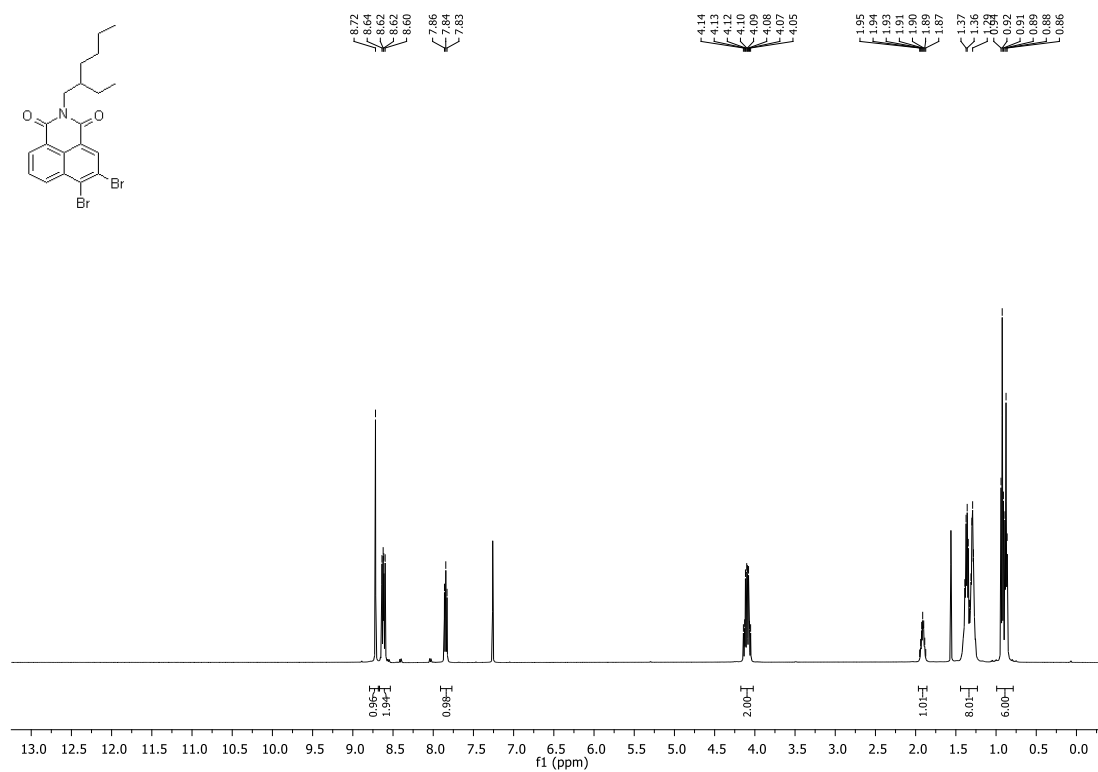


Figure S10: ^{13}C NMR spectrum of the compound **7**

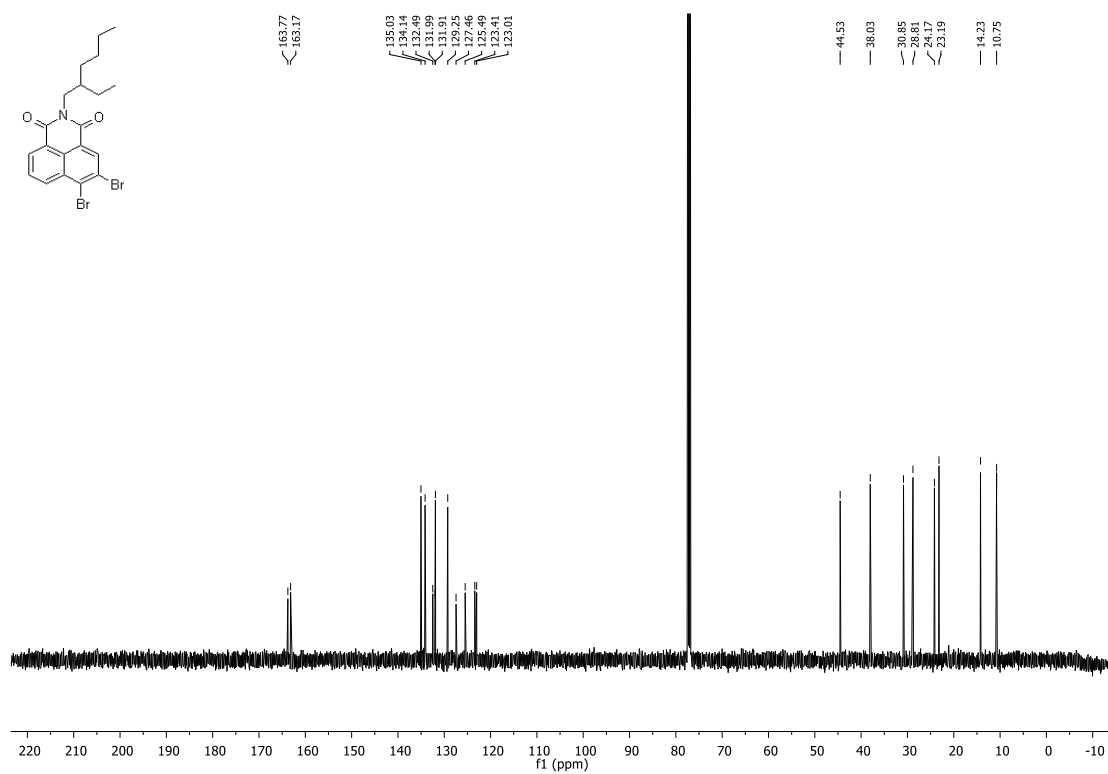


Figure S11: ^1H NMR spectrum of the compound **8**

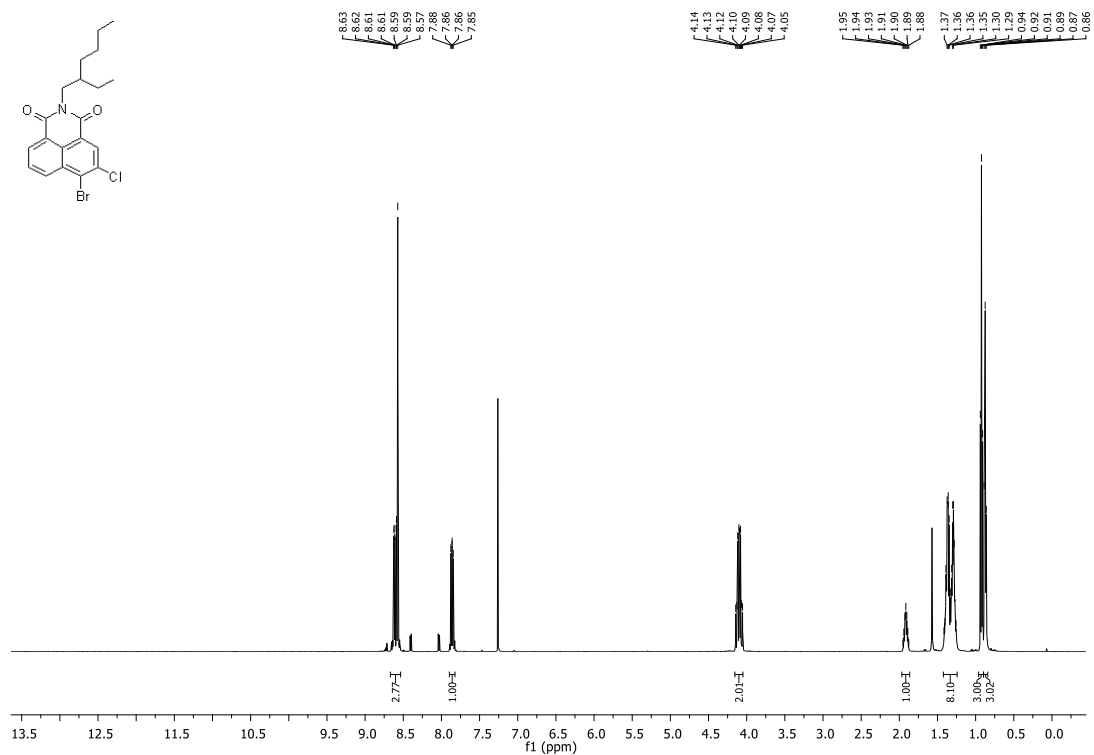


Figure S12: ^{13}C NMR spectrum of the compound **8**

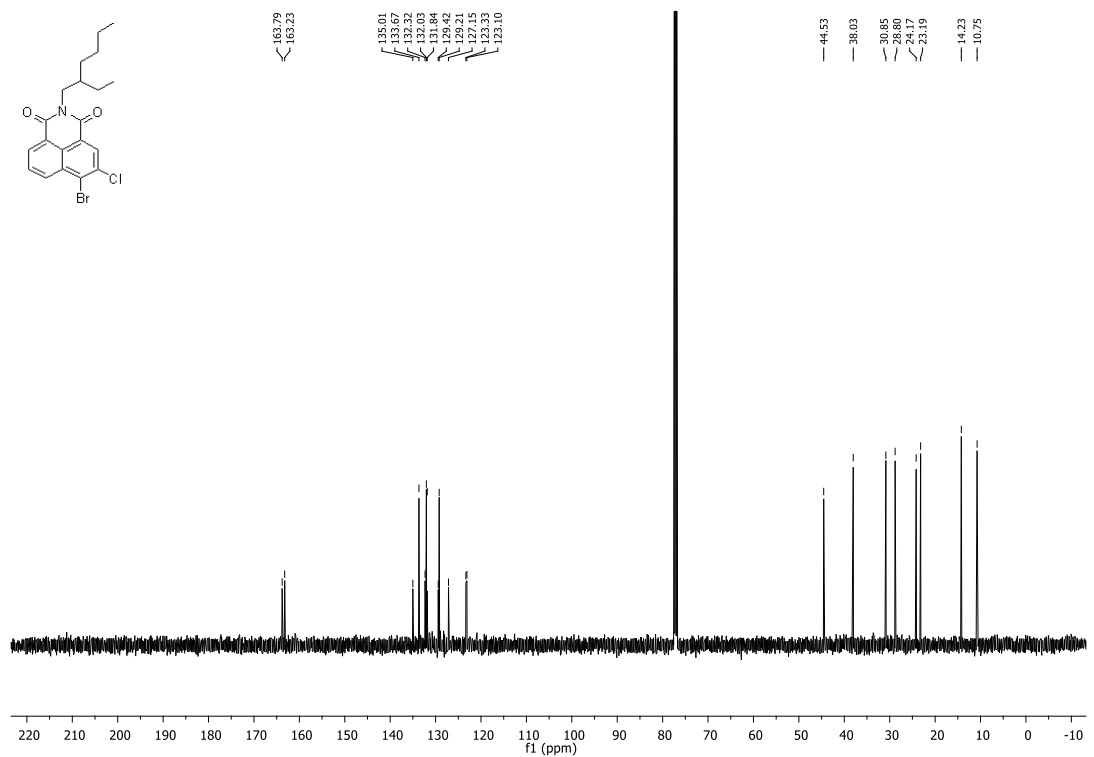


Figure S13: ^1H NMR spectrum of the compound **9**

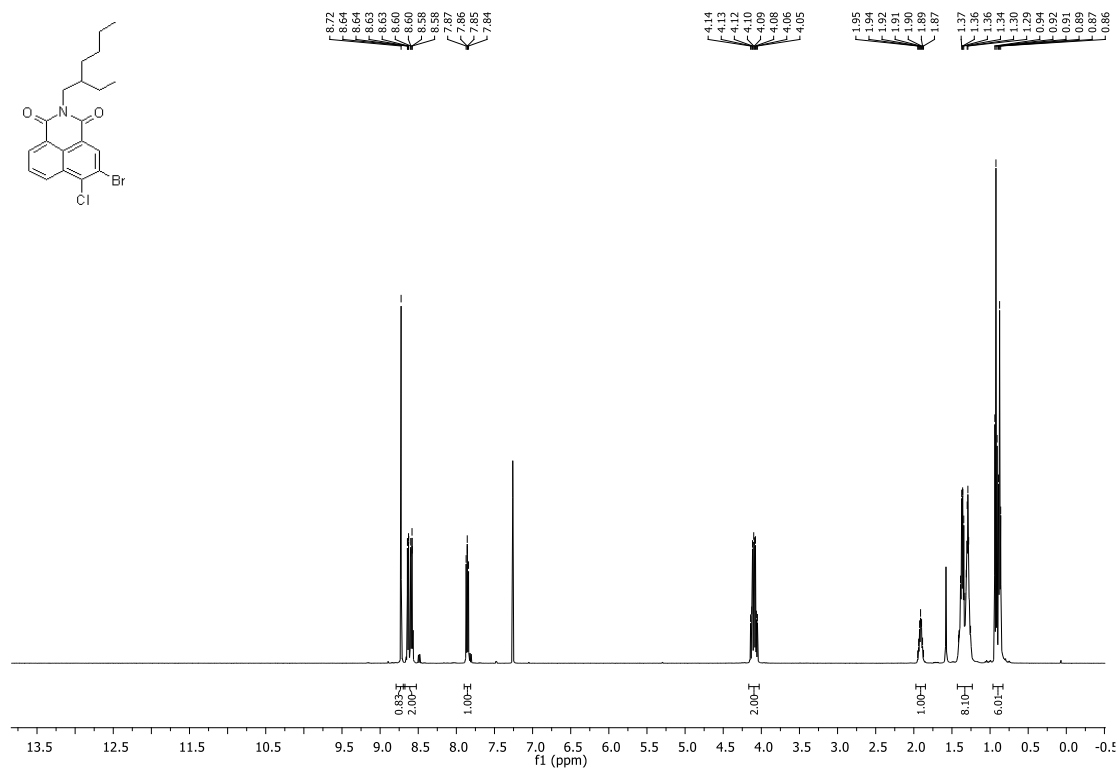


Figure S14: ^{13}C NMR spectrum of the compound **9**

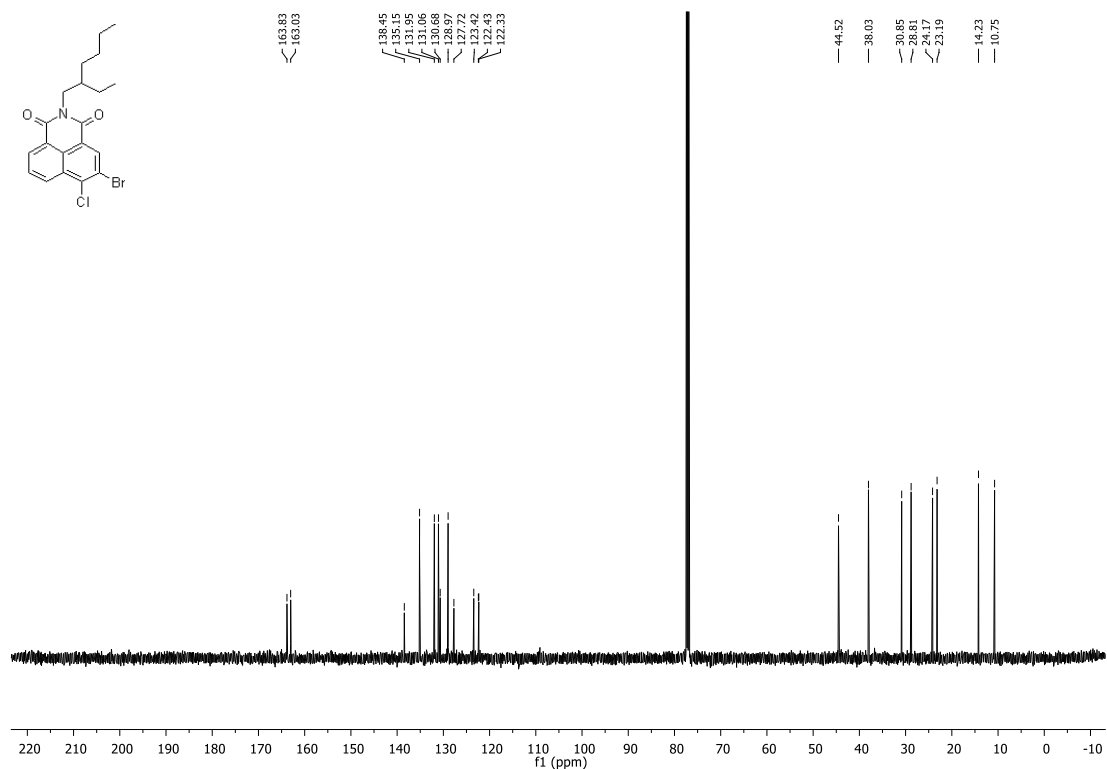


Figure S15: ^1H NMR spectrum of the compound **10**

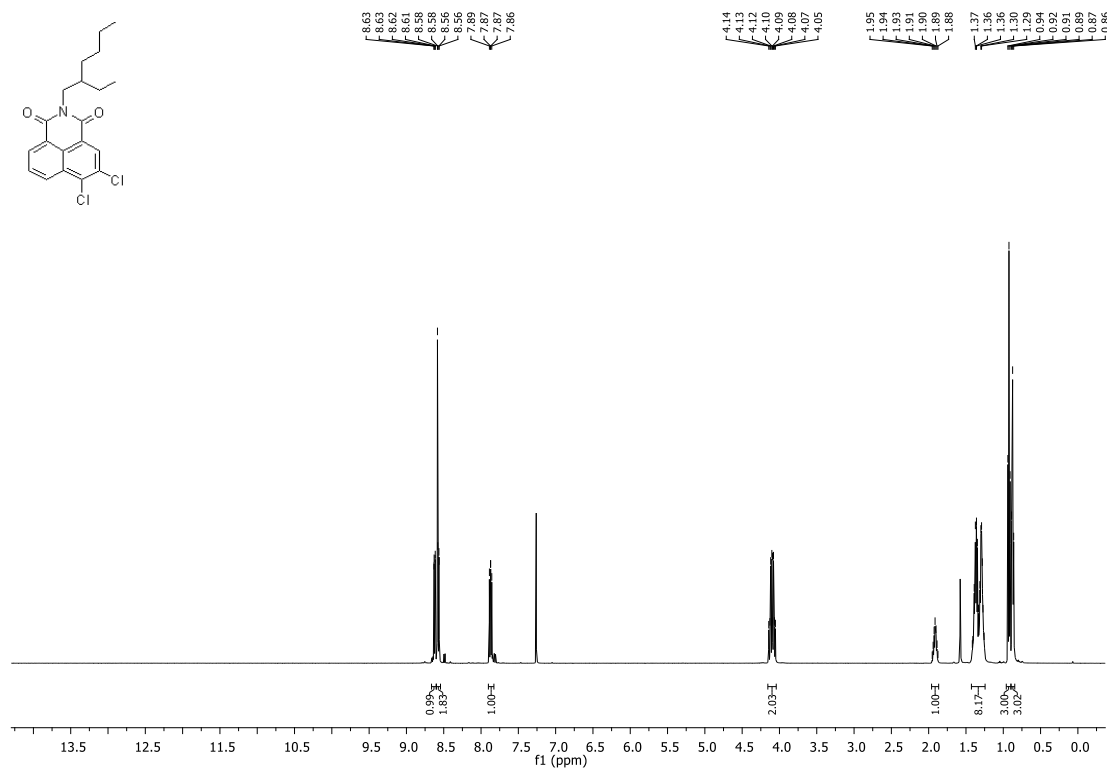


Figure S16: ^{13}C NMR spectrum of the compound **10**

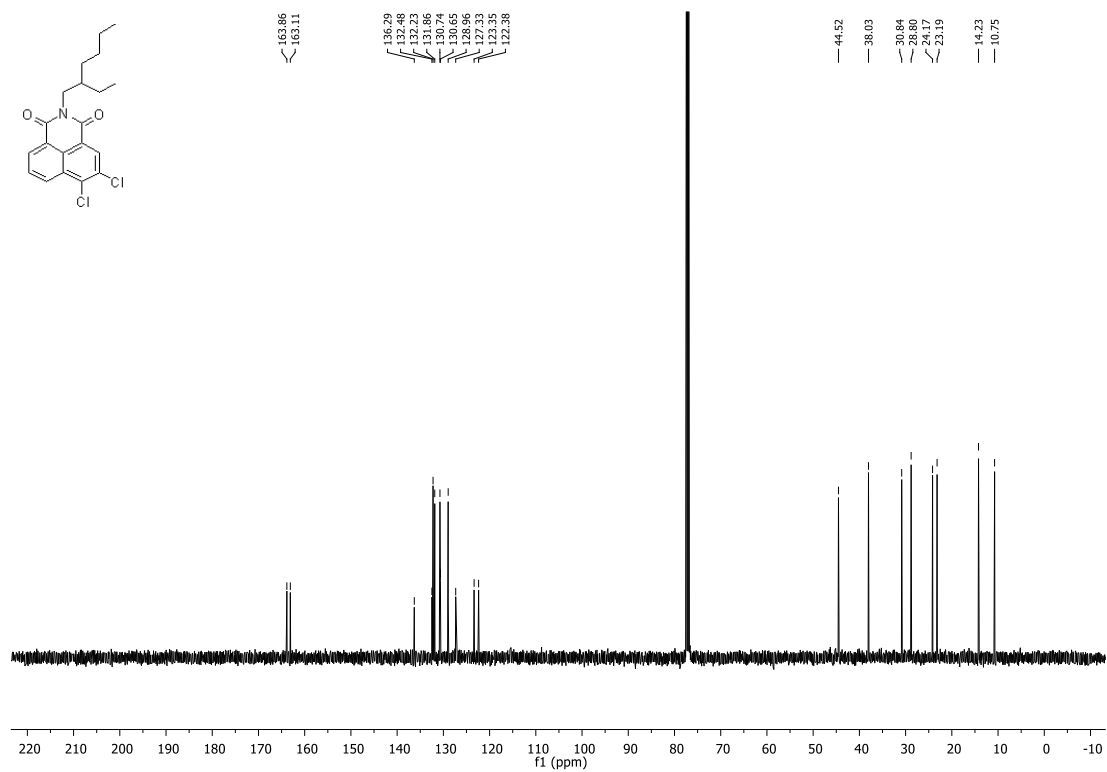
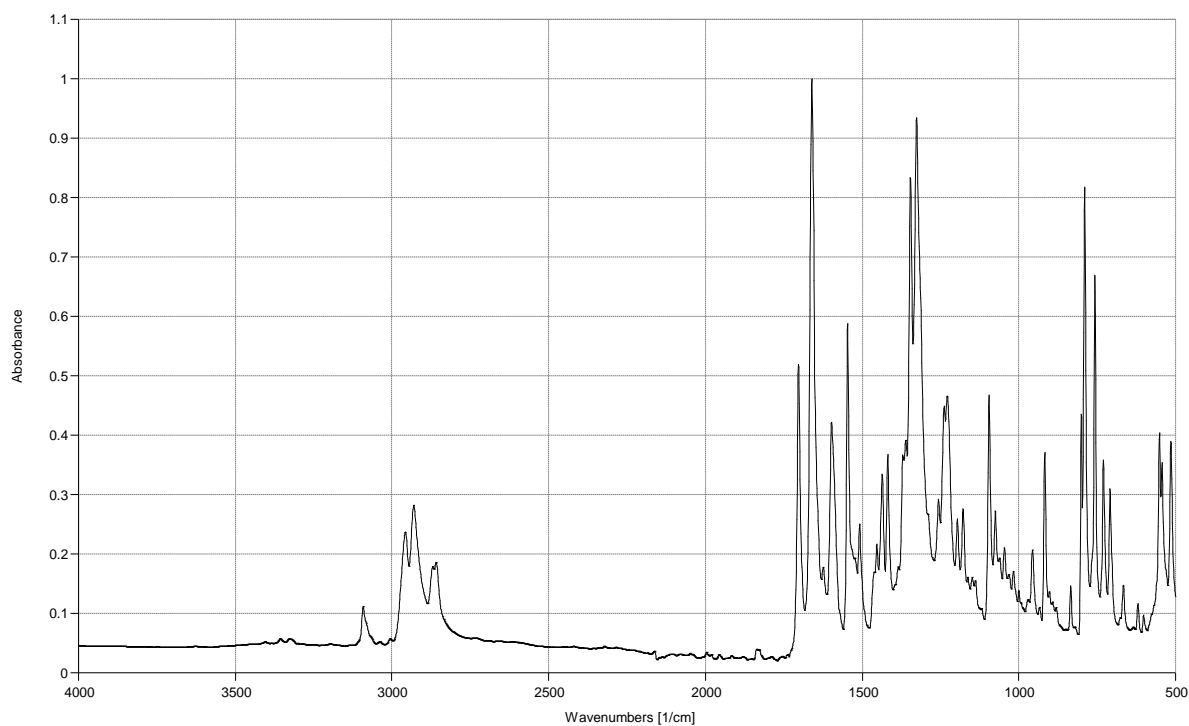
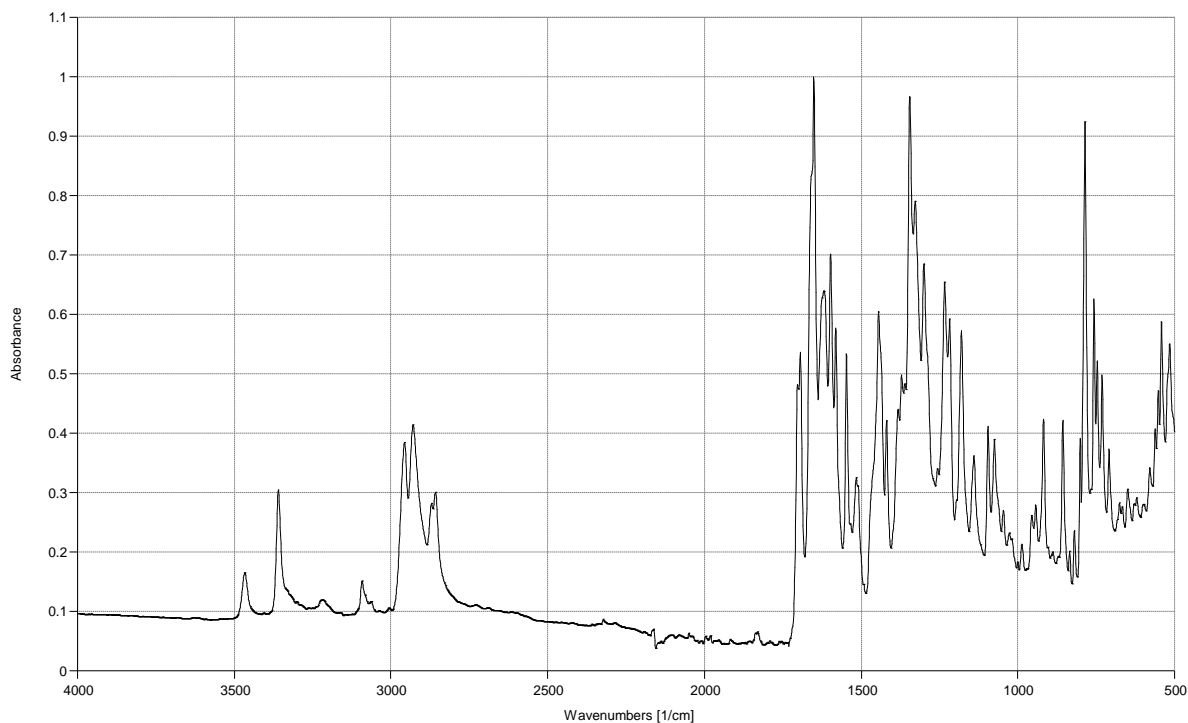


Figure S17. FT-IR spectrum and normalized absorption of the main bands of **3**



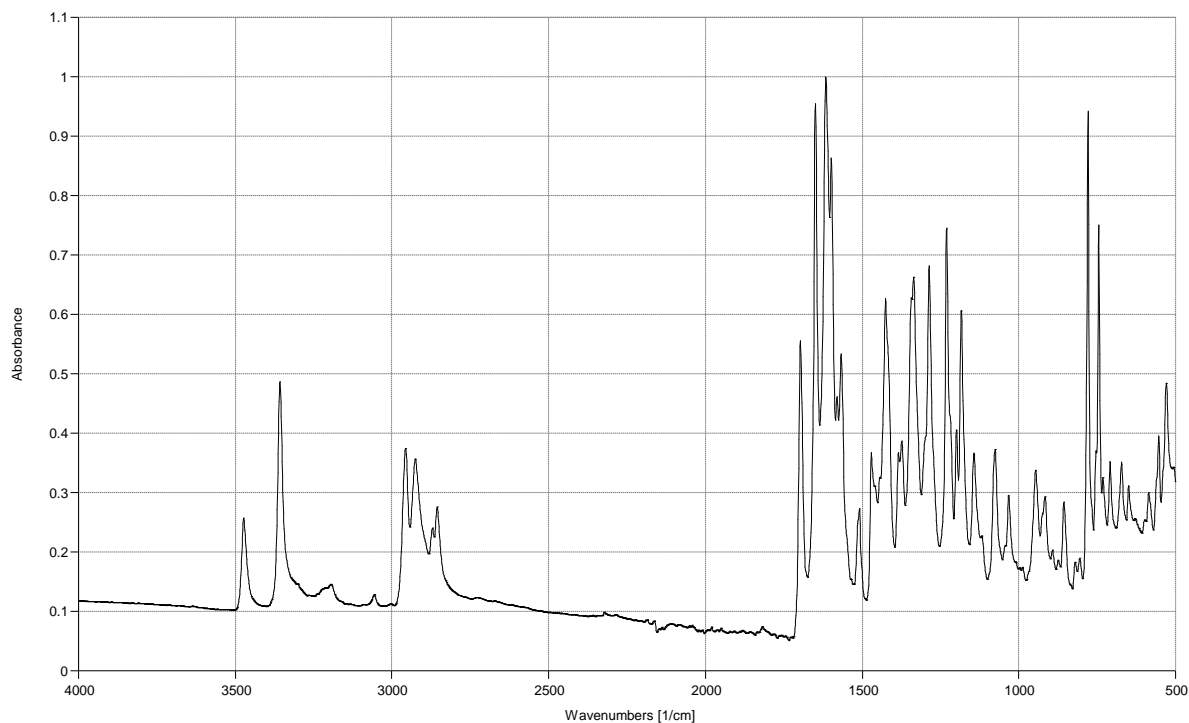
wavenumber	absorbance	wavenumber	absorbance
3093	0.1118	1229	0.4663
2958	0.2369	1197	0.259
2931	0.2823	1179	0.2759
2860	0.1858	1096	0.4676
1704	0.5198	1076	0.2725
1661	1	957	0.2069
1598	0.4218	918	0.3713
1547	0.588	791	0.8176
1509	0.2512	758	0.6692
1454	0.217	731	0.3583
1437	0.3343	710	0.3105
1419	0.3681	552	0.4043
1347	0.8337	516	0.3894
1327	0.9347		

Figure S18. FT-IR spectrum and normalized absorption of the main bands of **4**



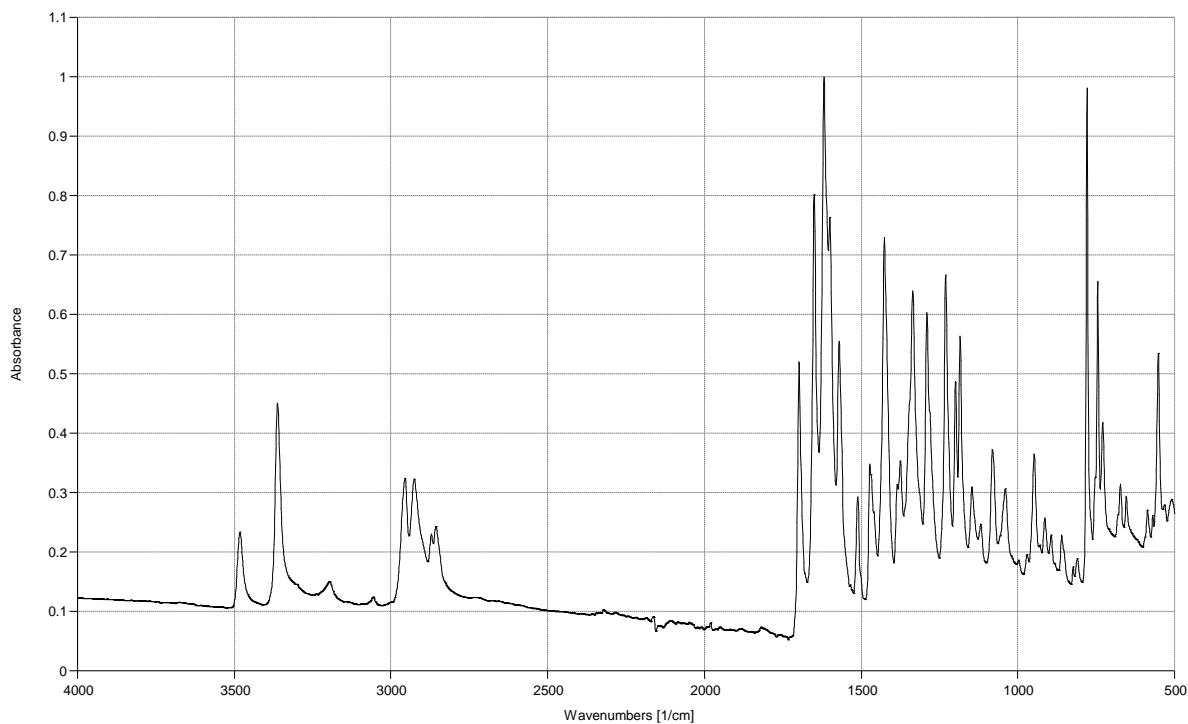
wavenumber	absorbance	wavenumber	absorbance	wavenumber	absorbance
3467	0.1654	1328	0.7909	836	0.2015
3360	0.3049	1300	0.6855	820	0.2362
2958	0.3847	1234	0.6551	787	0.9247
2931	0.4142	1218	0.593	758	0.6262
2859	0.301	1181	0.5727	732	0.4987
1695	0.5368	1141	0.3625	710	0.374
1652	1	1096	0.4123	677	0.2833
1620	0.6395	1076	0.39	650	0.3061
1598	0.7013	1047	0.2704	622	0.2915
1582	0.5772	1028	0.2323	599	0.2803
1548	0.5339	988	0.2133	580	0.3426
1517	0.3258	957	0.2616	543	0.5882
1445	0.6051	944	0.2793	516	0.5508
1420	0.4214	919	0.424		
1372	0.4984	889	0.2007		
1346	0.9673	857	0.4224		

Figure S19. FT-IR spectrum and normalized absorption of the main bands of **5**



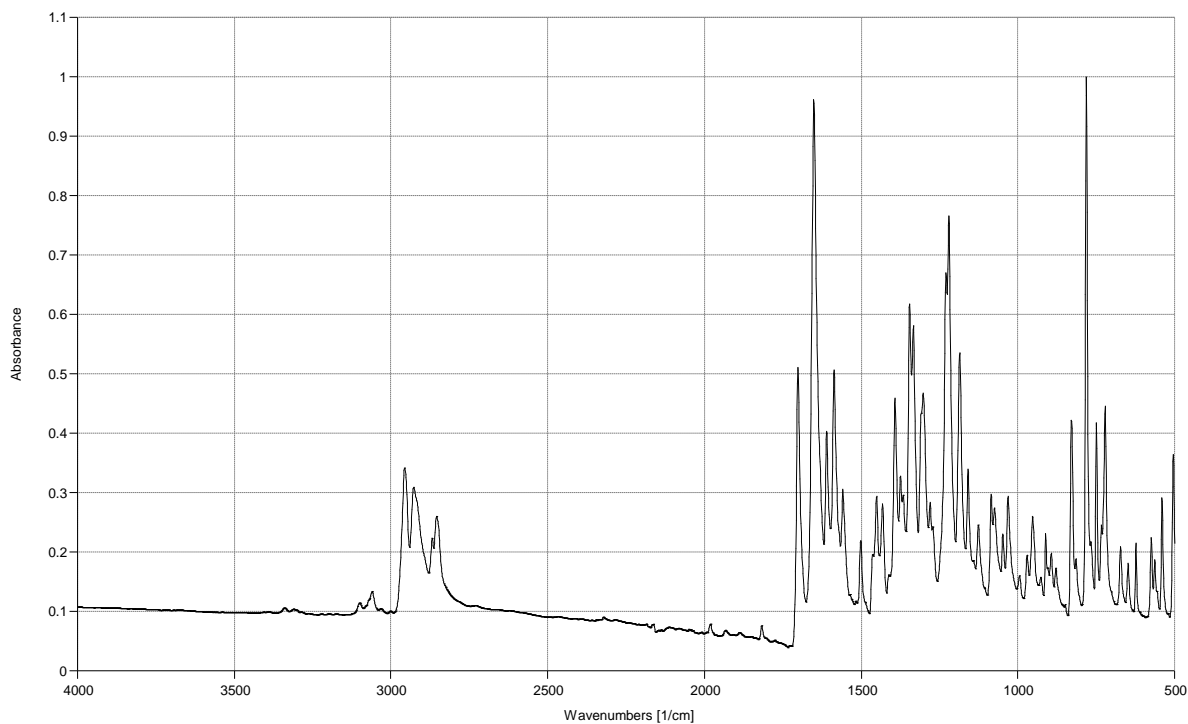
wavenumber	absorbance	wavenumber	absorbance	wavenumber	absorbance
3474	0.2575	1426	0.6267	894	0.2034
3358	0.4872	1374	0.3871	857	0.285
2957	0.3748	1337	0.6626	780	0.9421
2926	0.357	1287	0.6823	746	0.7509
2857	0.276	1231	0.7457	710	0.3529
1698	0.5559	1200	0.4058	673	0.3513
1650	0.9551	1184	0.6065	651	0.3115
1617	1	1144	0.367	587	0.3003
1599	0.8633	1077	0.3727	554	0.3958
1568	0.5339	1033	0.2956	530	0.4844
1509	0.2739	947	0.3381		
1472	0.3677	918	0.293		

Figure S20. FT-IR spectrum and normalized absorption of the main bands of **6**



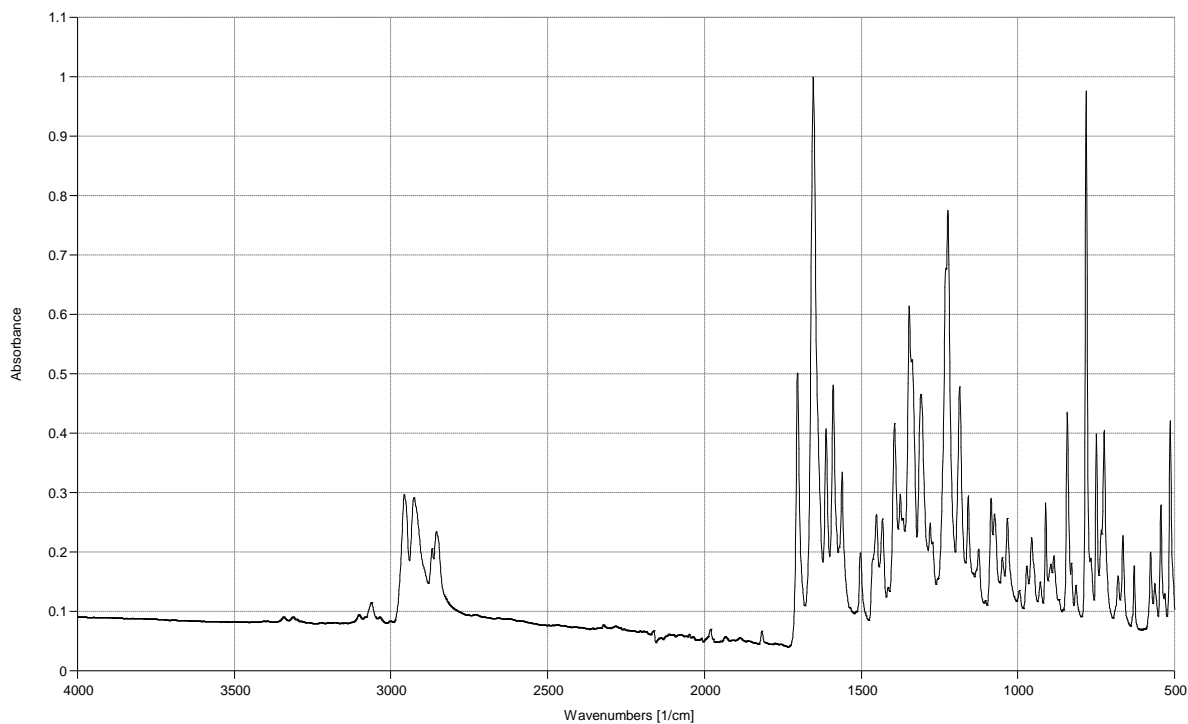
wavenumber	absorbance	wavenumber	absorbance	wavenumber	absorbance
3483	0.2335	1427	0.7301	915	0.2576
3363	0.4509	1376	0.3537	894	0.2288
2956	0.325	1336	0.64	861	0.2284
2927	0.3232	1291	0.6032	780	0.9815
2872	0.2302	1231	0.6673	746	0.6561
2857	0.2433	1200	0.4872	730	0.4183
1699	0.5205	1185	0.5636	674	0.3142
1650	0.802	1148	0.3096	655	0.2942
1619	1	1119	0.2473	587	0.2711
1571	0.5553	1082	0.3729	553	0.5344
1512	0.2931	1041	0.3068	510	0.2886
1473	0.3482	949	0.3651		

Figure S21. FT-IR spectrum and normalized absorption of the main bands of **7**



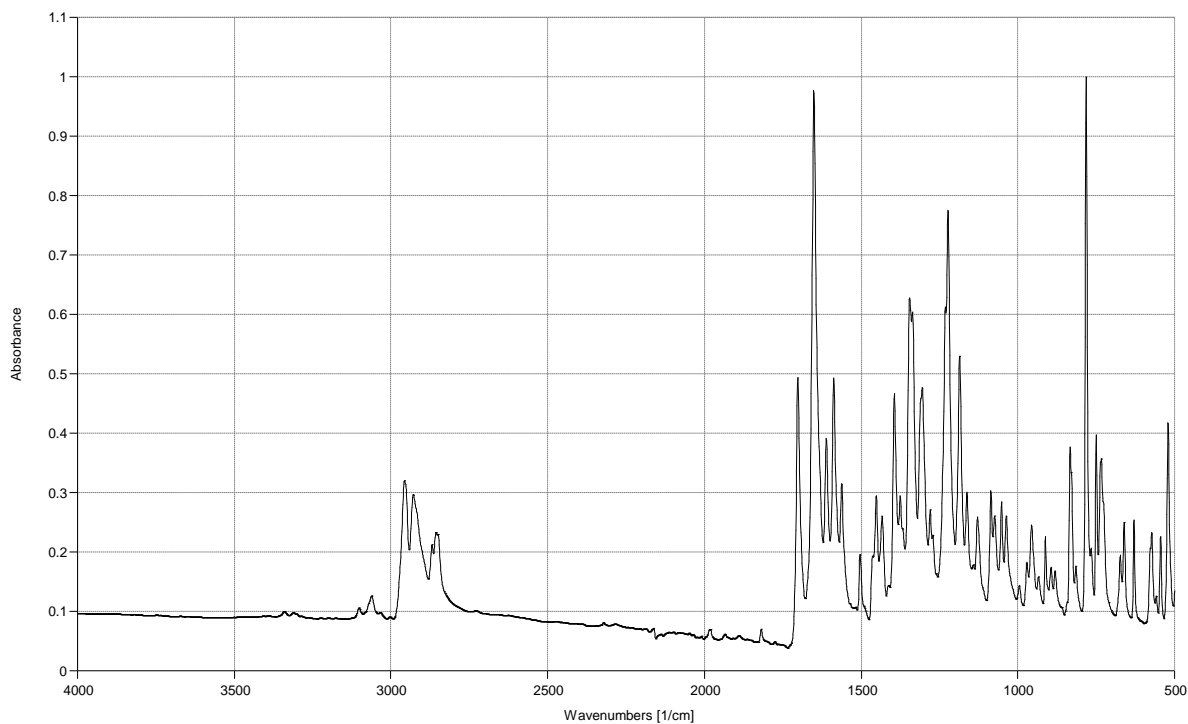
wavenumber	absorbance	wavenumber	absorbance	wavenumber	absorbance
3101	0.1144	1432	0.2811	954	0.2599
3061	0.1336	1393	0.4594	912	0.2316
3033	0.1048	1375	0.3277	830	0.4217
3003	0.1007	1346	0.6175	782	1
2957	0.3418	1334	0.5815	750	0.4178
2928	0.3091	1303	0.4674	722	0.4454
2856	0.26	1281	0.2838	673	0.2097
1702	0.5113	1221	0.7659	624	0.2155
1652	0.9618	1186	0.5353	575	0.2243
1611	0.4036	1160	0.3399	541	0.2915
1587	0.5065	1127	0.2461	505	0.3645
1559	0.3056	1086	0.2974		
1502	0.2197	1049	0.2308		
1451	0.2942	1032	0.2939		

Figure S22. FT-IR spectrum and normalized absorption of the main bands of **8**



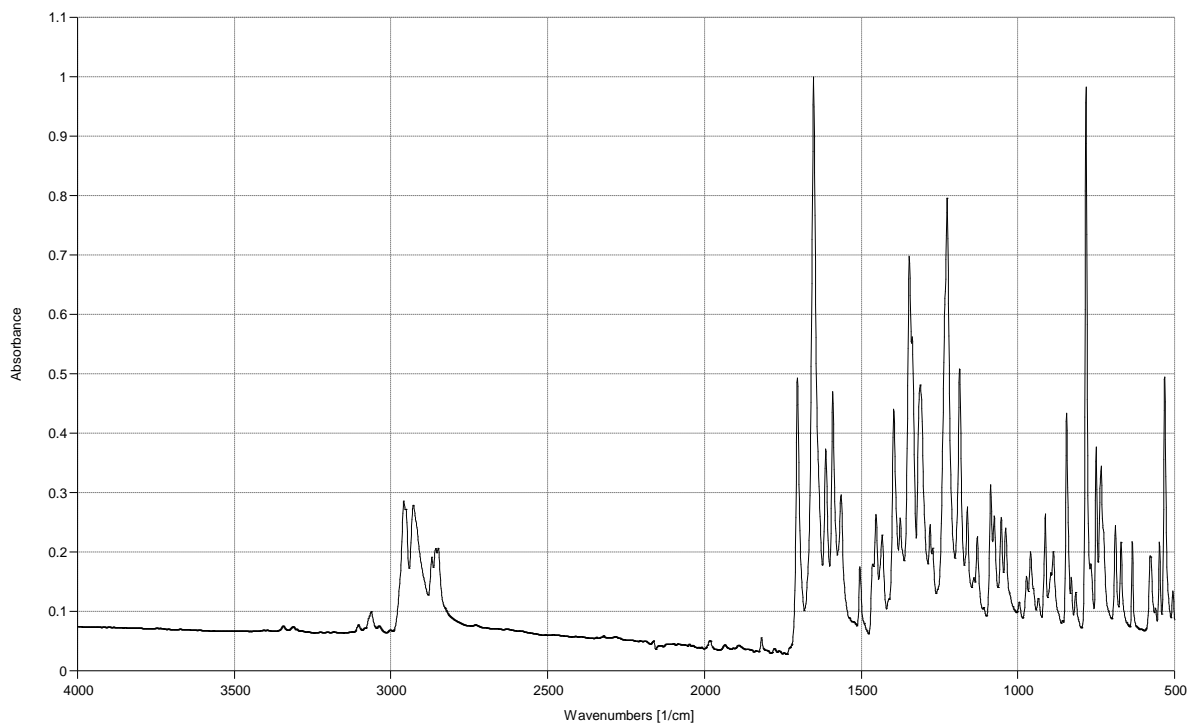
wavenumber	absorbance	wavenumber	absorbance	wavenumber	absorbance
3103	0.0946	1452	0.2636	1034	0.2571
3064	0.1153	1433	0.2563	957	0.2245
3037	0.091	1395	0.4163	912	0.2833
3003	0.0842	1376	0.2976	843	0.4354
2959	0.2968	1347	0.6141	783	0.9767
2927	0.2914	1310	0.4655	750	0.3989
2856	0.2343	1281	0.249	725	0.4051
1704	0.5014	1224	0.7753	666	0.2281
1654	1	1186	0.4784	544	0.2797
1613	0.4072	1159	0.2952	515	0.4208
1590	0.4817	1126	0.2052		
1561	0.3346	1086	0.291		
1503	0.1987	1051	0.1908		

Figure S23. FT-IR spectrum and normalized absorption of the main bands of **9**



wavenumber	absorbance	wavenumber	absorbance	wavenumber	absorbance
3103	0.106	1434	0.2608	957	0.2456
3063	0.1262	1395	0.4668	913	0.2259
3036	0.0984	1376	0.2949	834	0.3769
2958	0.3201	1346	0.6283	783	1
2930	0.2969	1306	0.4772	751	0.3979
2857	0.2331	1281	0.2716	734	0.358
1703	0.4943	1224	0.7754	662	0.2502
1652	0.9773	1186	0.53	630	0.254
1612	0.3915	1163	0.3007	574	0.2332
1588	0.4929	1130	0.259	545	0.2261
1563	0.3151	1087	0.303	522	0.4177
1505	0.1956	1053	0.2846		
1452	0.295	1038	0.2612		

Figure S24. FT-IR spectrum and normalized absorption of the main bands of **10**



wavenumber	absorbance	1227	0.7957
3105	0.0776	1187	0.5082
3064	0.0996	1162	0.2762
3040	0.0758	1130	0.2266
2960	0.2862	1088	0.3134
2930	0.2789	1054	0.2582
2850	0.2066	1040	0.2408
1704	0.4935	wavenumber	absorbance
1653	1	960	0.2005
1614	0.3733	913	0.264
1591	0.47	888	0.2007
1565	0.2967	845	0.4335
1505	0.1751	783	0.9828
1453	0.2633	751	0.3768
wavenumber	absorbance	735	0.3447
1434	0.229	690	0.2447
1397	0.4404	671	0.2166
1376	0.2572	636	0.2179
1347	0.6983	549	0.2173
1312	0.4818	532	0.4945
1281	0.2465		

Figure S25: HRMS spectrum of compound 4

YZ-24A #86-242 RT: 0.10-0.28 AV: 157 NL: 6.31E9
T: FTMS + p ESI Full ms [150.0000-2000.0000]

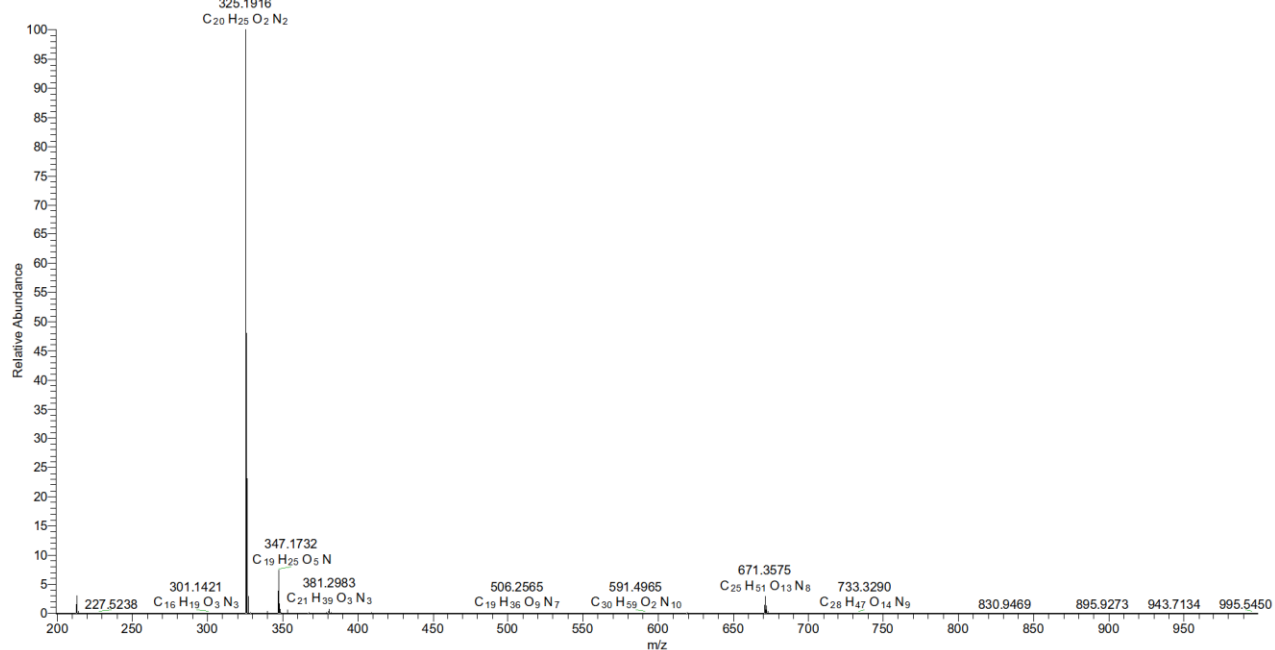


Figure S26: HRMS spectrum of compound 5

YZ-25A #128-259 RT: 0.15-0.30 AV: 132 SB: 233 0.01-0.10, 0.34-0.51 NL: 2.02E8
T: FTMS + p ESI Full ms [150.0000-2000.0000]

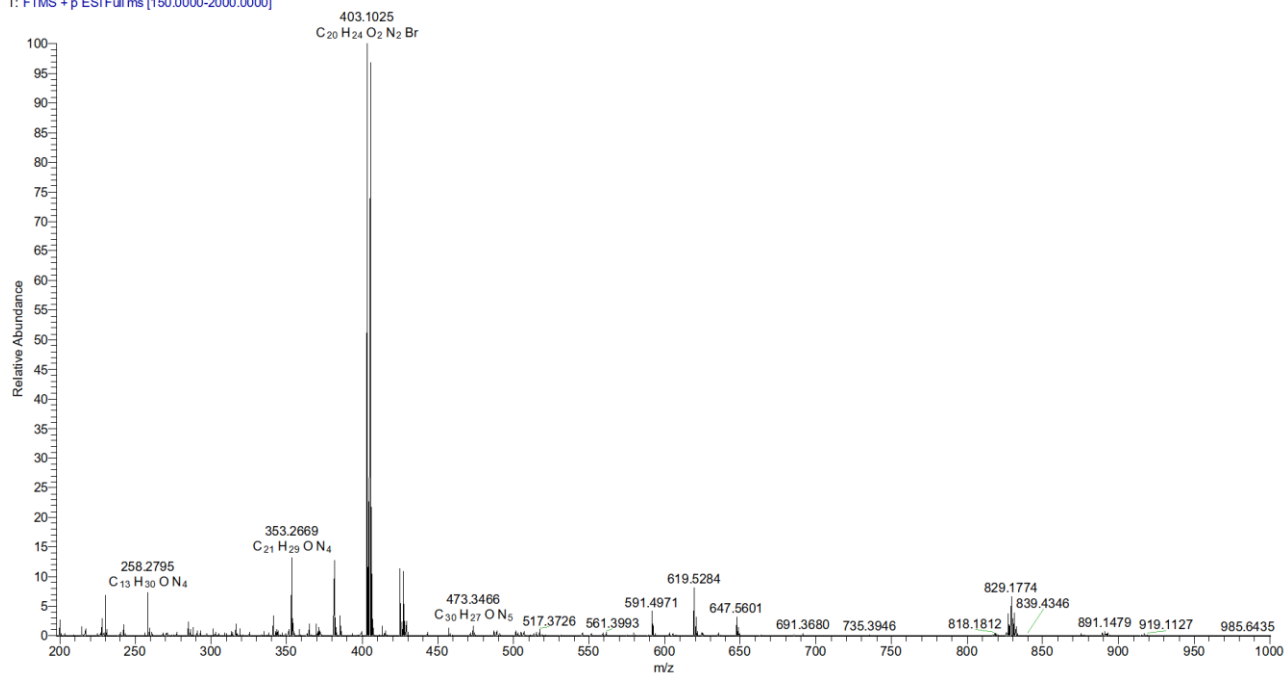


Figure S27: HRMS spectrum of compound 6

YZ-26A #107-243 RT: 0.13-0.28 AV: 137 NL: 4.82E8
T: FTMS + p ESI Full ms [150.0000-2000.0000]

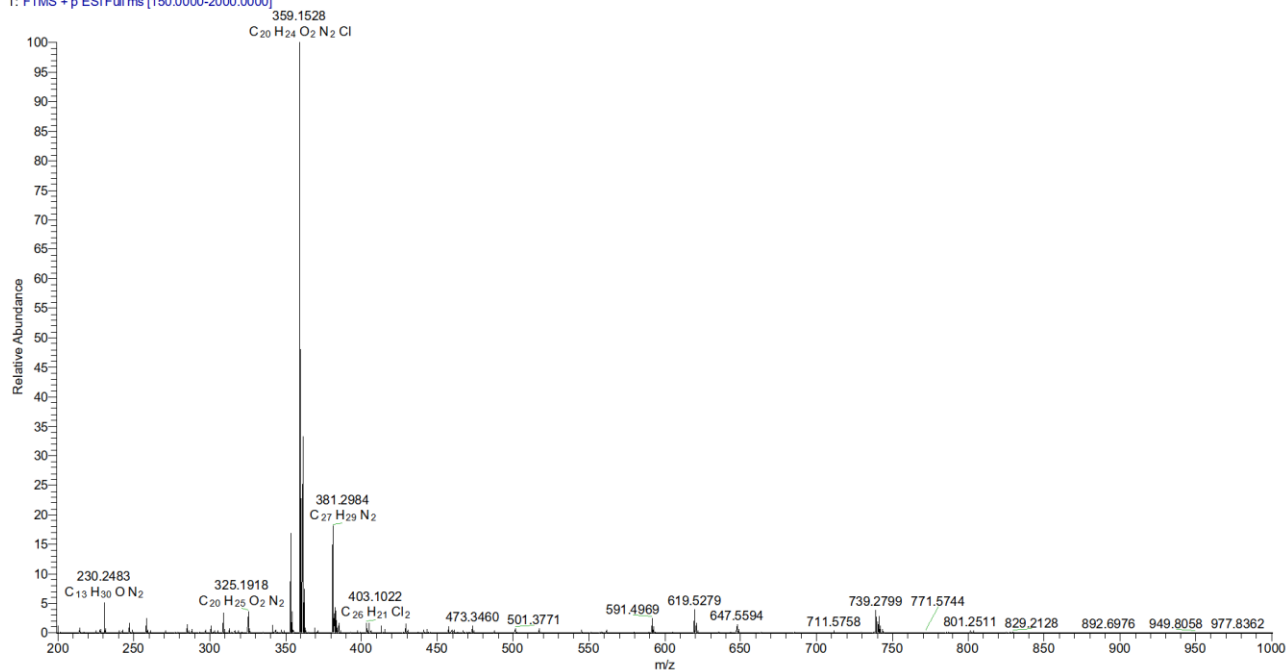


Figure S28: HRMS spectrum of compound 7

YZ-27 #58 RT: 0.13 AV: 1 NL: 1.01E7
T: FTMS + p APCI corona Full ms [250.0000-1750.0000]

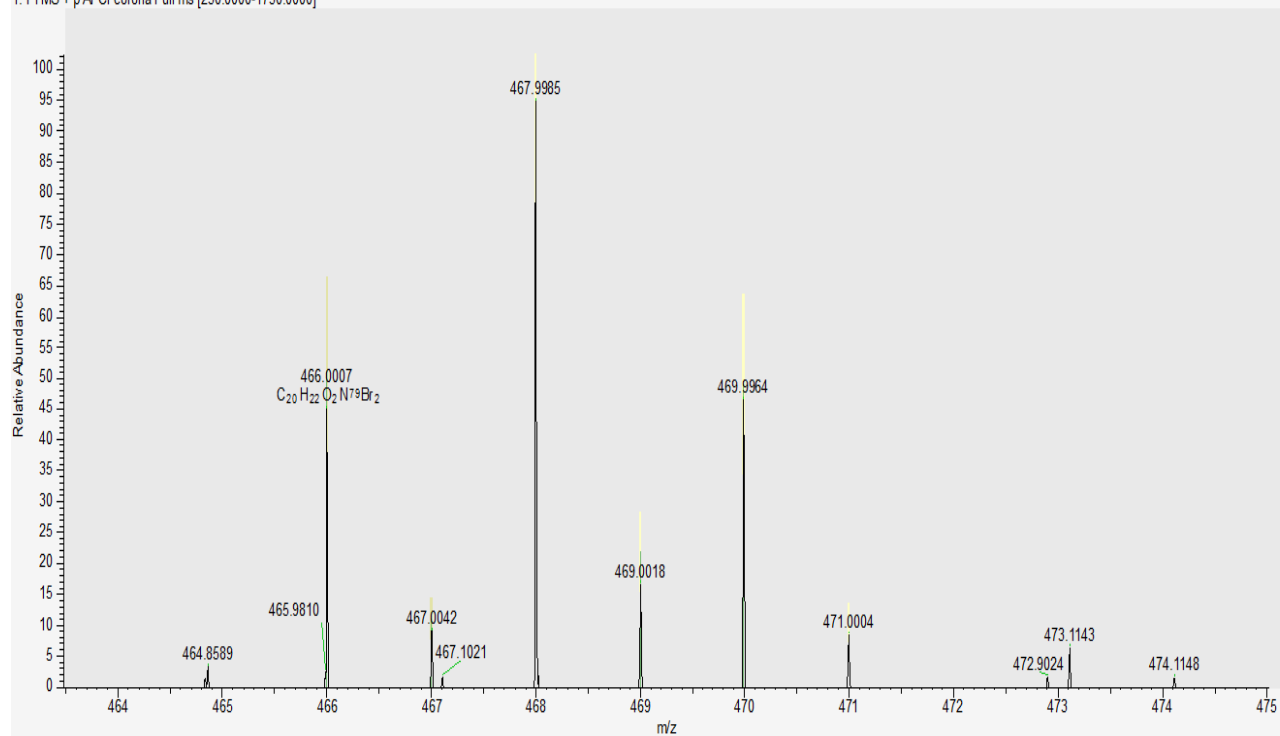


Figure S29: HRMS spectrum of compound 8

YZ-28 #38 RT: 0.08 AV: 1 NL: 9.19E7
T: FTMS + p APCI corona Full ms [250.0000-1750.0000]

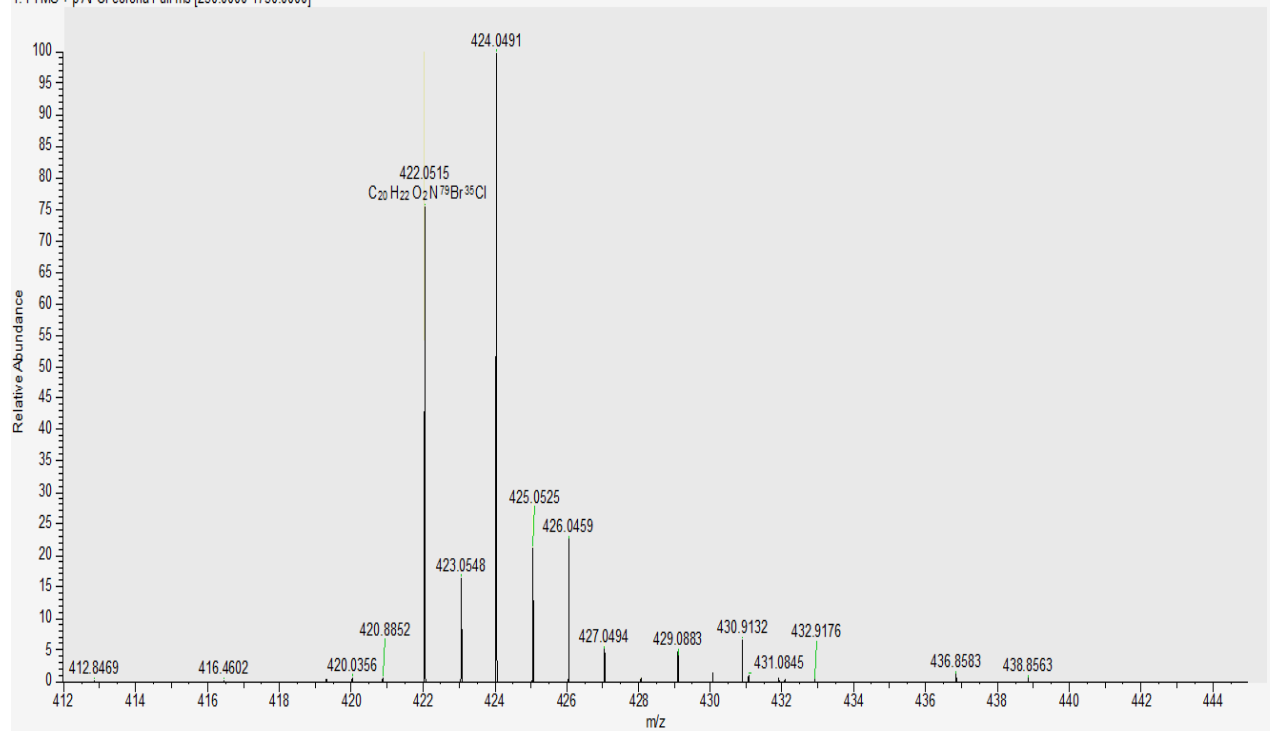


Figure S30: HRMS spectrum of compound 9

YZ-29 #55 RT: 0.12 AV: 1 NL: 1.83E7
T: FTMS + p APCI corona Full ms [250.0000-1750.0000]

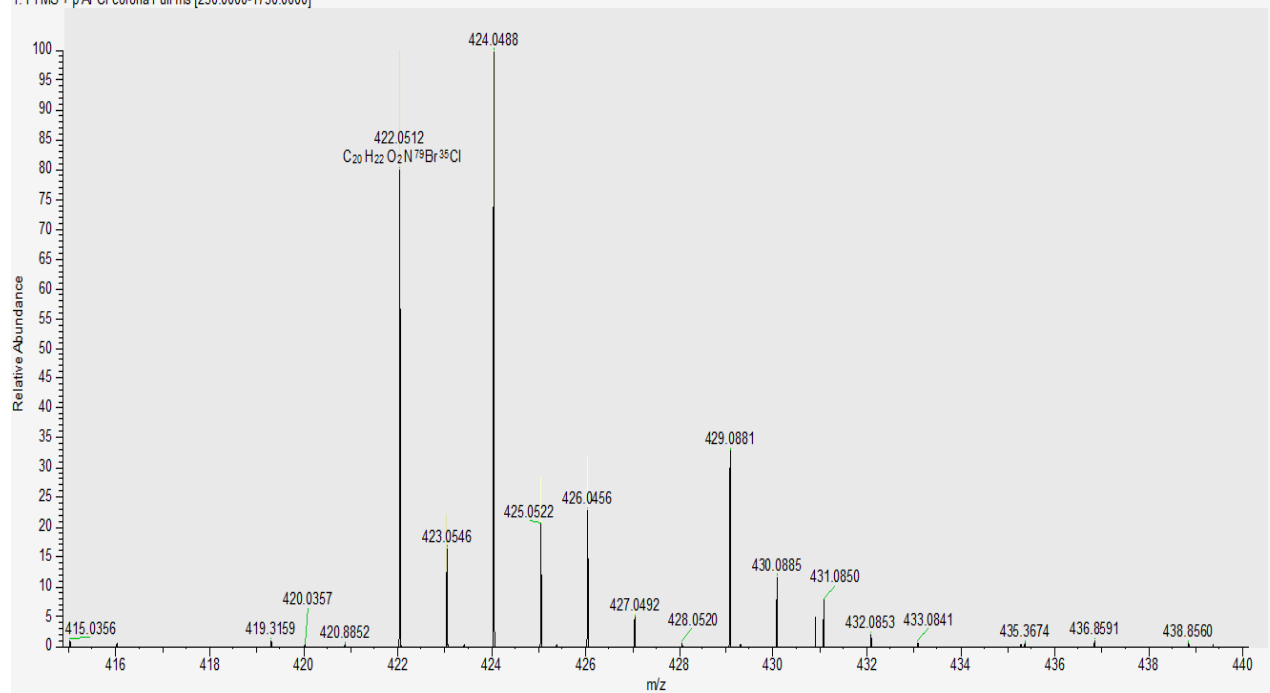


Figure S31: HRMS spectrum of compound **10**

YZ-210 #37 RT: 0.08 AV: 1 NL: 3.47E7

T: FTMS + p APCI corona Full ms [250.0000-1750.0000]

