Electronic and Steric Optimization of Fluorogenic Probes for Biomolecular Imaging

Wen Chyan,[†] Henry R. Kilgore,[‡] Brian Gold,[†] and Ronald T. Raines*[,†,§]

[†]Department of Chemistry, [‡]Graduate Program in Biophysics, and [§]Department of Biochemistry, University of Wisconsin–Madison, Madison, Wisconsin 53706, United States

*rtraines@wisc.edu

Content	Page

Table S1. Kinetic parameters were obtained by fitting Michaelis–Menten plots generated from the initial rates of probe-unmasking in 10 mM HEPES–NaOH buffer, pH 7.3, containing PLE (Figure S3).

Fluorophore (Probe)	Number of Masking Groups	Auto-immolative Linker	k_{cat}/K_M ($M^{-1}s^{-1}$)	K_M (μM)
fluorescein (**1a**)[5]	2	—	1.4×10^6	11
2′,7′-difluorofluorescein (**1b**)[5]	2	—	2.9×10^5	5.3
2′,7′-dichlorofluorescein (**1c**)	2	—	2.8×10^6	1.8
fluorescein[5]	2	AM ether	6.8×10^5	3.2
2′,7′-difluorofluorescein[5]	2	AM ether	3.8×10^5	4.9
2′,7′-dichlorofluorescein (**AM**)	2	AM ether	8.4×10^5	2.2
2′,7′-dichlorofluorescein (**3b**)	2	—	1.8×10^6	4.6
morpholino-urea-rhodamine[6]	1	trimethyl lock	8.2×10^5	0.10

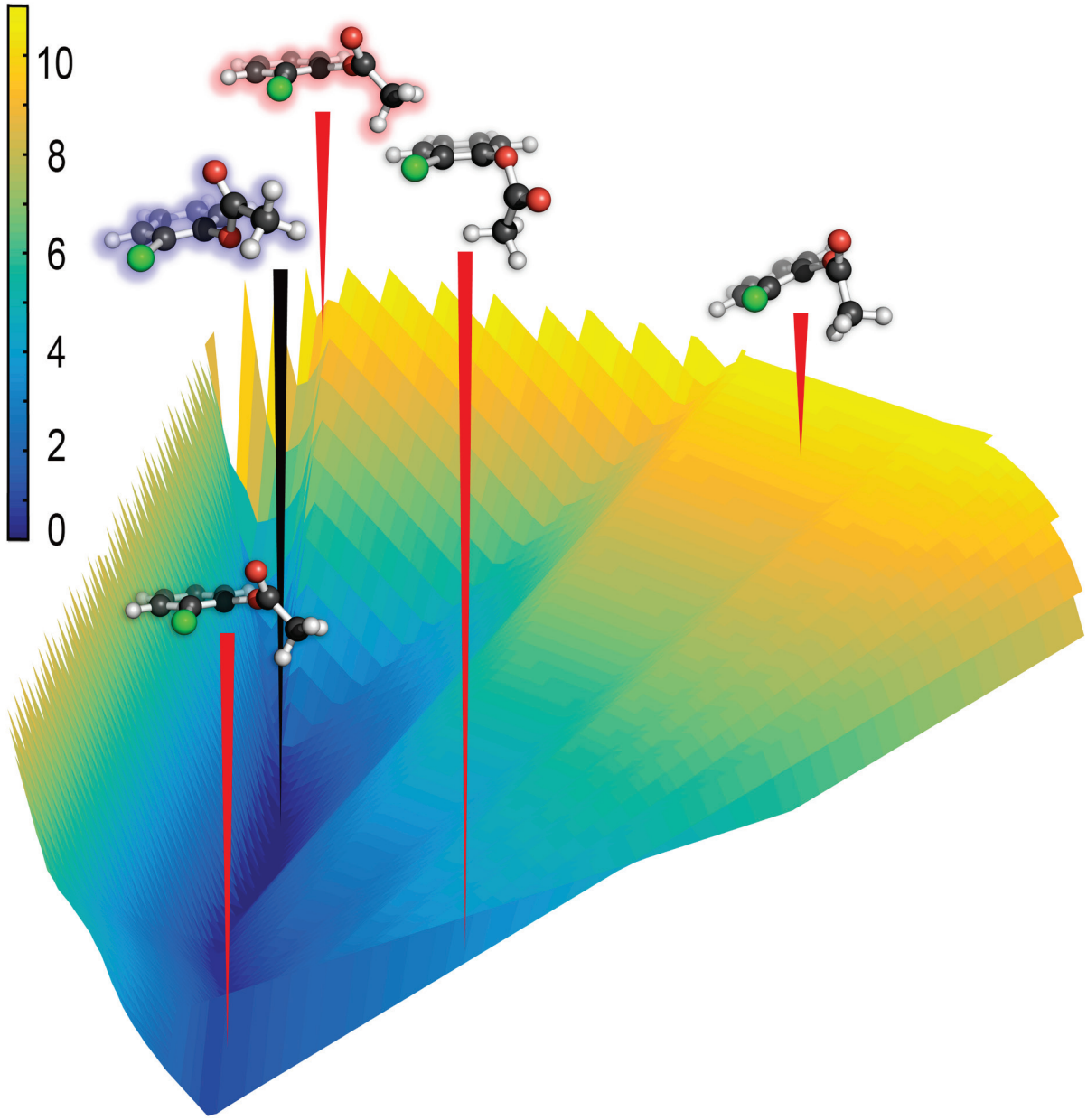


Figure S1. 3D Rendering of the 2D potential-energy surface for 2-chlorophenyl acetate (**2c**) in Figure 3C. Lowest energy conformations (blue) correspond to regions with favorable $n\rightarrow\pi^*$ interactions and the ester in a *syn* conformation. Highest energy conformations (yellow) are caused by unfavorable $n)(\pi$ Pauli repulsion and rotational barriers. Although the *anti* conformation is not preferred, when 2-chlorophenyl acetate adopts a conformation with an $n\rightarrow\pi^*$ interaction of the same strength as the *syn* conformation, the ΔE between the *syn* and *anti* conformations is only 2.66 kcal/mol. Reducing the distance d and angle θ leads to the highest energy conformation (red highlight) with a maximum difference of 11.77 kcal/mol at $d = 2.92$ Å and $\theta = 93.5°$, as the carbonyl carbon enters the plane of the phenyl ring.

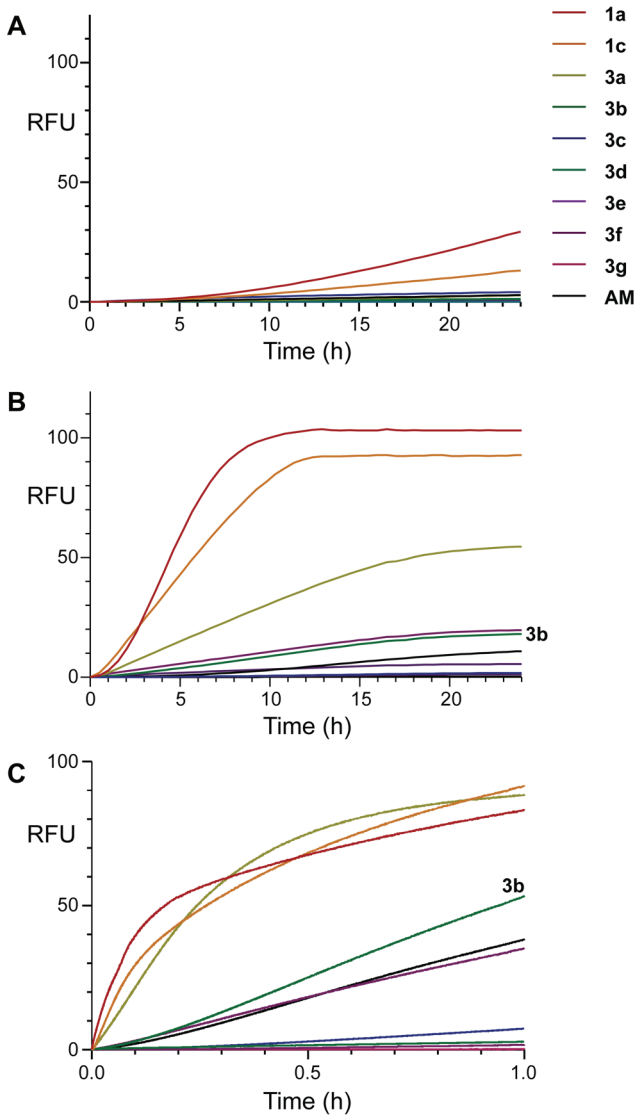


Figure S2. Graphs showing the time-course for the hydrolysis of probes **1a**, **1c**, **3a–g**, and **AM** as measured by the generation of fluorescence. Probe concentrations were 5 µM. (A) Spontaneous hydrolysis in 10 mM HEPES–NaOH buffer, pH 7.3. (B) Spontaneous hydrolysis in OptiMEM containing FBS (10% v/v). (C) Enzyme-catalyzed hydrolysis in 10 mM HEPES–NaOH buffer, pH 7.3, containing PLE (50 ng/mL). RFU: relative fluorescence units.

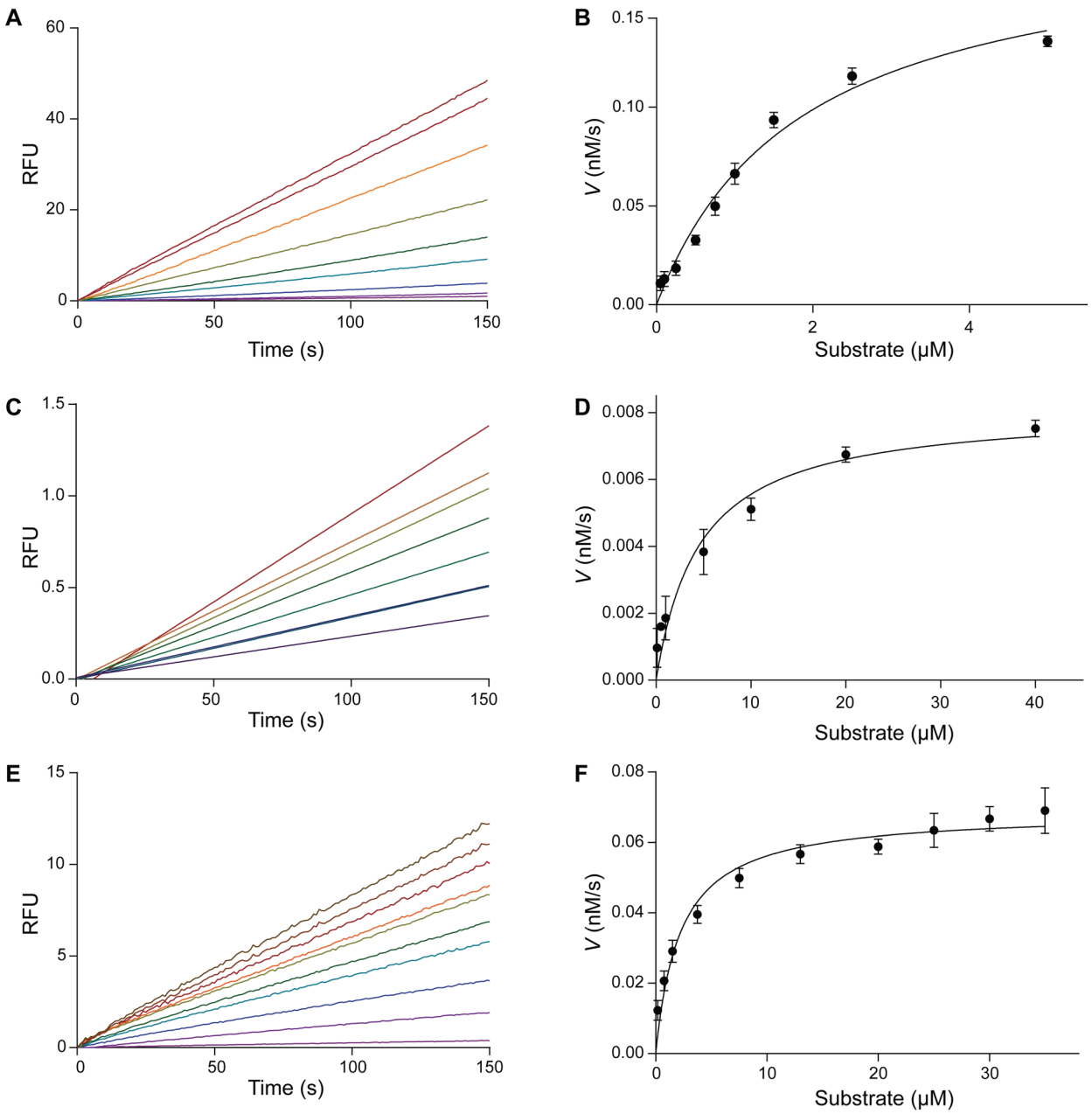


Figure S3. Kinetic traces and Michaelis–Menten plots for the unmasking of fluorogenic probes. Assays were performed in 10 mM HEPES–NaOH buffer, pH 7.3, containing PLE (9 ng/mL). Substrate was added at $t = -60$ s, and enzyme was added at $t = 0$. (A, B) Probe **1c**; $k_{cat}/K_M = 2.8 \times 10^6$ $M^{-1}s^{-1}$ and $K_M = 1.8$ μM. (C, D) Probe **3b**; $k_{cat}/K_M = 1.8 \times 10^6$ $M^{-1}s^{-1}$ and $K_M = 4.6$ μM. (E, F) **AM**; $k_{cat}/K_M = 8.4 \times 10^5$ $M^{-1}s^{-1}$ and $K_M = 2.2$ μM.

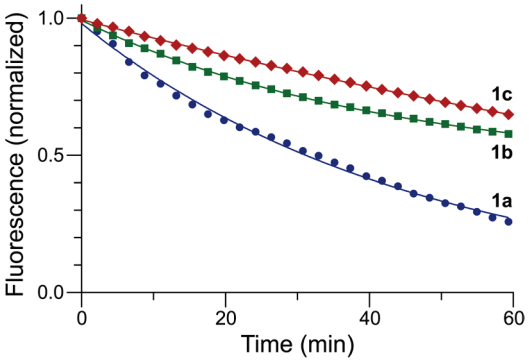


Figure S4. Rate of fluorophore photobleaching in live HeLa cells under continuous illumination. Cells were incubated with **1a**, **1b**, or **1c** (4 μM) for 15 min, washed twice, and images were acquired at 2-min intervals with continuous illumination between measurements. 2′,7′-Dichlorofluorescein (which is unmasked **1c**) had significantly greater resistance to photobleaching than did either fluorescein (unmasked **1a**) or difluorofluorescein (unmasked **1b**).

References

(1) Critchfield, F. E.; Gibson, J. A.; Hall, J. L. *J. Am. Chem. Soc.* **1953**, *75*, 1991–1992.

(2) French, A. P.; Mills, S.; Swarup, R.; Bennett, M. J.; Pridmore, T. P. *Nat. Protoc.* **2008**, *3*, 619–628.

(3) Frisch, M. J.; Trucks, G. W.; Schlegel, H. B.; Scuseria, G. E.; Robb, M. A.; Cheeseman, J. R.; Scalmani, G.; Barone, V.; Mennucci, B.; Petersson, G. A.; Nakatsuji, H.; Caricato, M.; Li, X.; Hratchian, H. P.; Izmaylov, A. F.; Bloino, J.; Zheng, G.; Sonnenberg, J. L.; Hada, M.; Ehara, M.; Toyota, K.; Fukuda, R.; Hasegawa, J.; Ishida, M.; Nakajima, T.; Honda, Y.; Kitao, O.; Nakai, H.; Vreven, T.; Montgomery, J. A., Jr.; Peralta, J. E.; Ogliaro, F.; Bearpark, M.; Heyd, J. J.; Brothers, E.; Kudin, K. N.; Staroverov, V. N.; Kobayashi, R.; Normand, J.; Raghavachari, K.; Rendell, A.; Burant, J. C.; Iyengar, S. S.; Tomasi, J.; Cossi, M.; Rega, N.; Millam, J. M.; Klene, M.; Knox, J. E.; Cross, J. B.; Bakken, V.; Adamo, C.; Jaramillo, J.; Gomperts, R.; Stratmann, R. E.; Yazyev, O.; Austin, A. J.; Cammi, R.; Pomelli, C.; Ochterski, J. W.; Martin, R. L.; Morokuma, K.; Zakrzewski, V. G.; Voth, G. A.; Salvador, P.; Dannenberg, J. J.; Dapprich, S.; Daniels, A. D.; Farkas, Ö.; Foresman, J. B.; Ortiz, J. V.; Cioslowski, J.; Fox, D. J. *Gaussian 09, Revision D.01*, Gaussian, Inc.: Wallingford, CT, 2009.

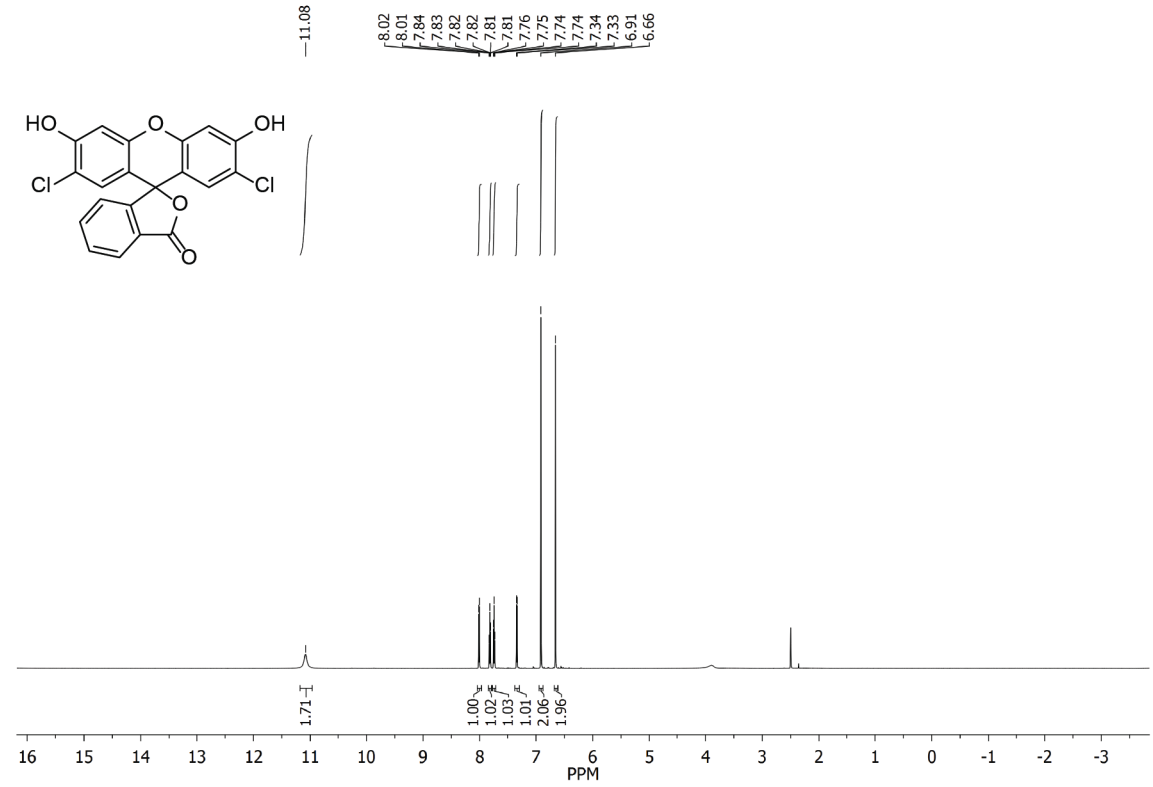
(4) Glendening, E. D.; Badenhoop, J. K.; Reed, A. E.; Carpenter, J. E.; Bohmann, J. A.; Morales, C. M.; Weinhold, F. *NBO 6.0*, Madison, WI, 2012.

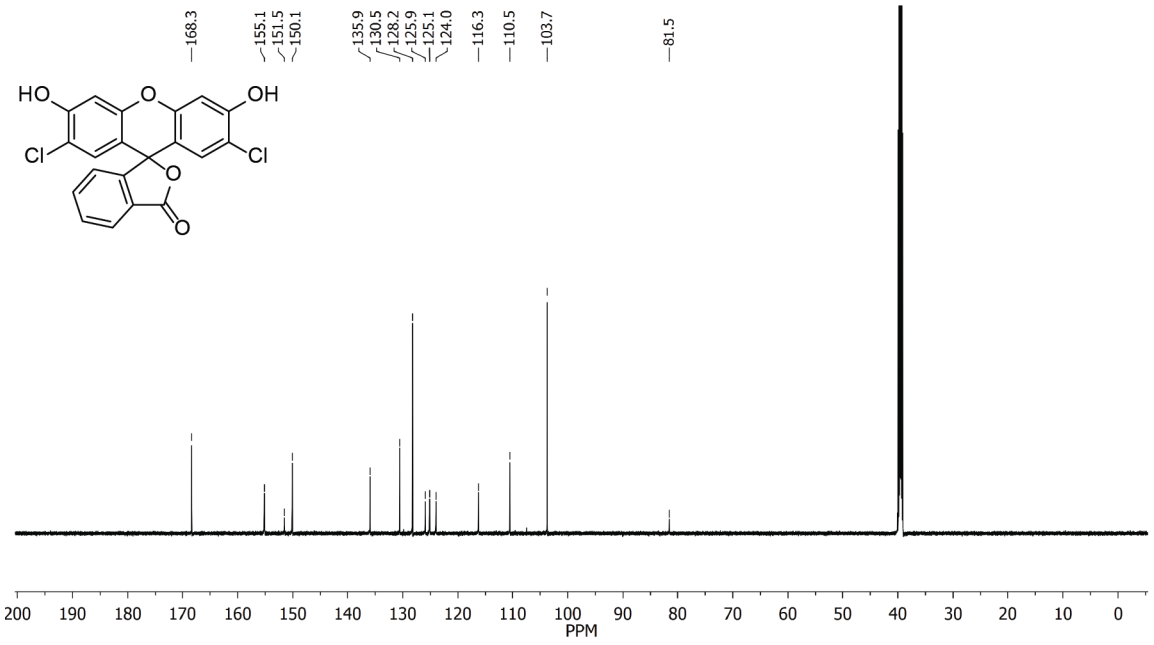
(5) Lavis, L. D.; Chao, T.-Y.; Raines, R. T. *Chem. Sci.* **2011**, *2*, 521–530.

(6) Lavis, L. D.; Chao, T.-Y.; Raines, R. T. *ACS Chem. Biol.* **2006**, *1*, 252–260.

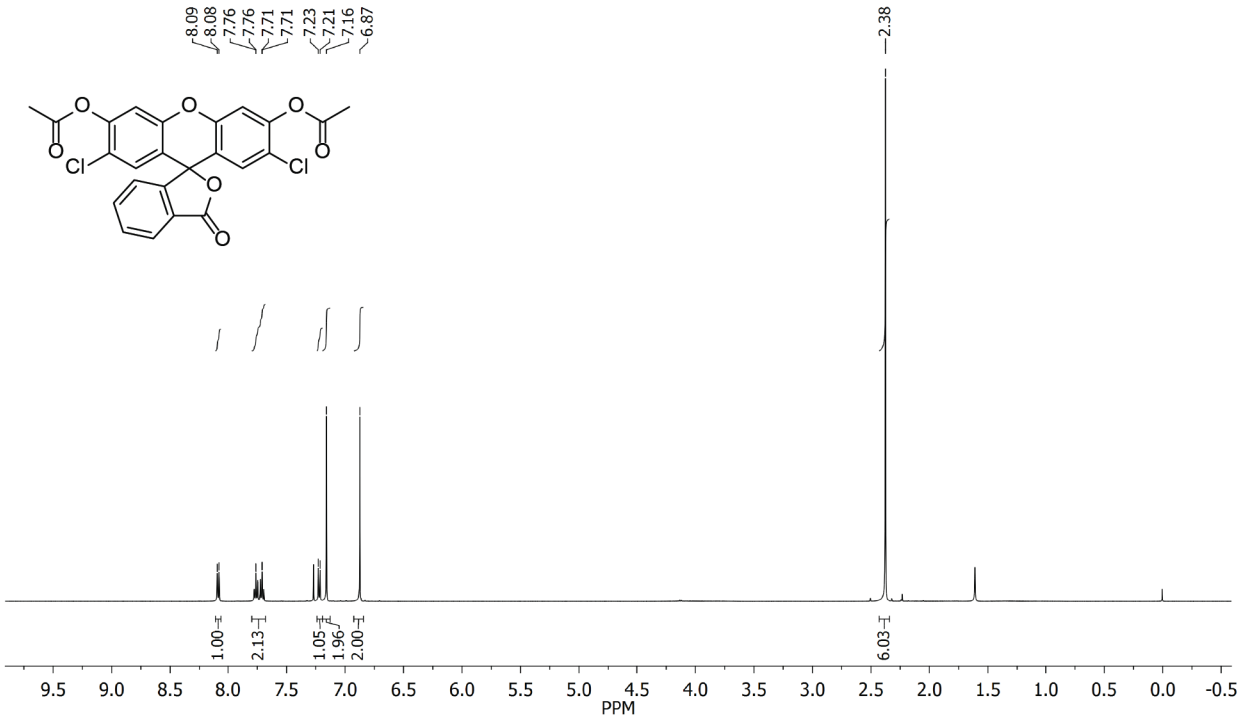
NMR Spectra

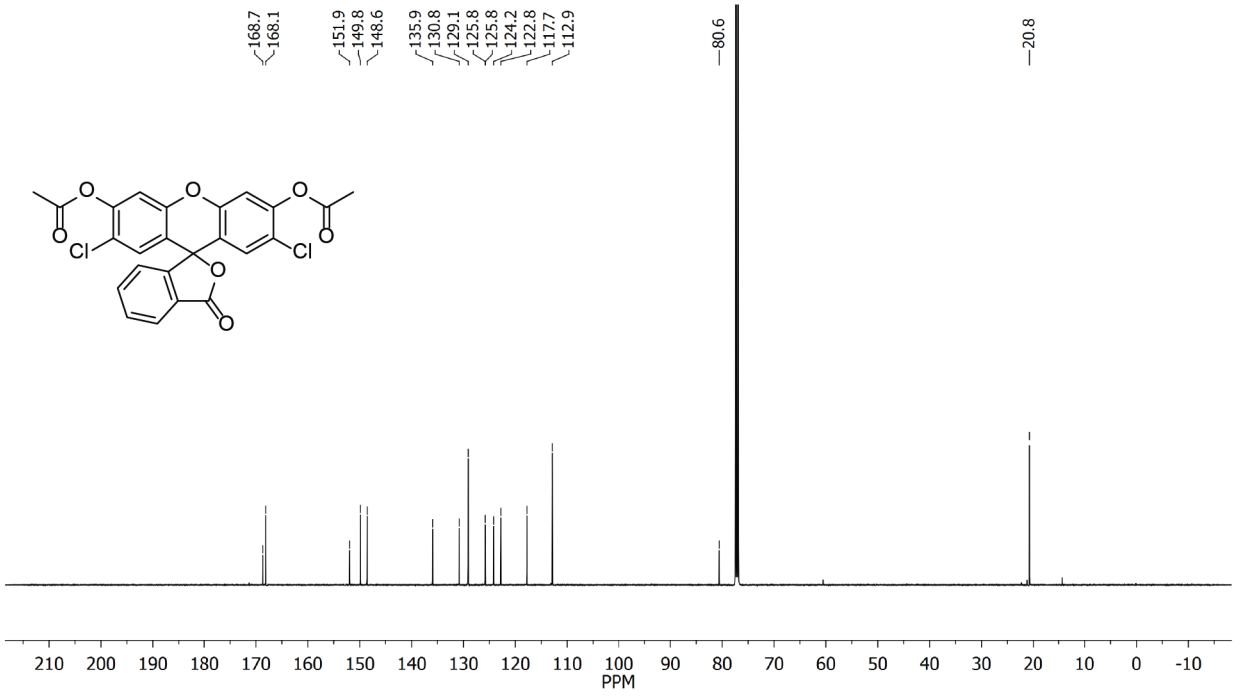
^{1}H NMR ($(CD_3)_2SO$) and ^{13}C NMR ($(CD_3)_2SO$) Spectra of 2′,7′-Dichlorofluorescein



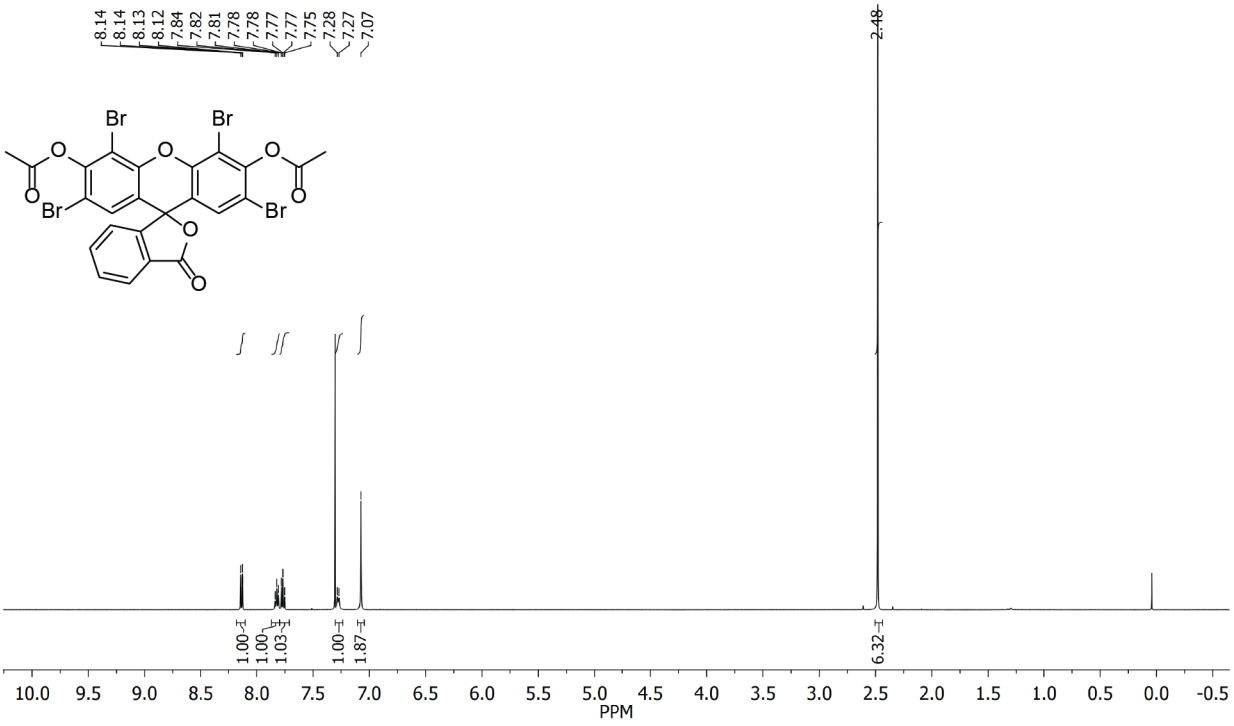


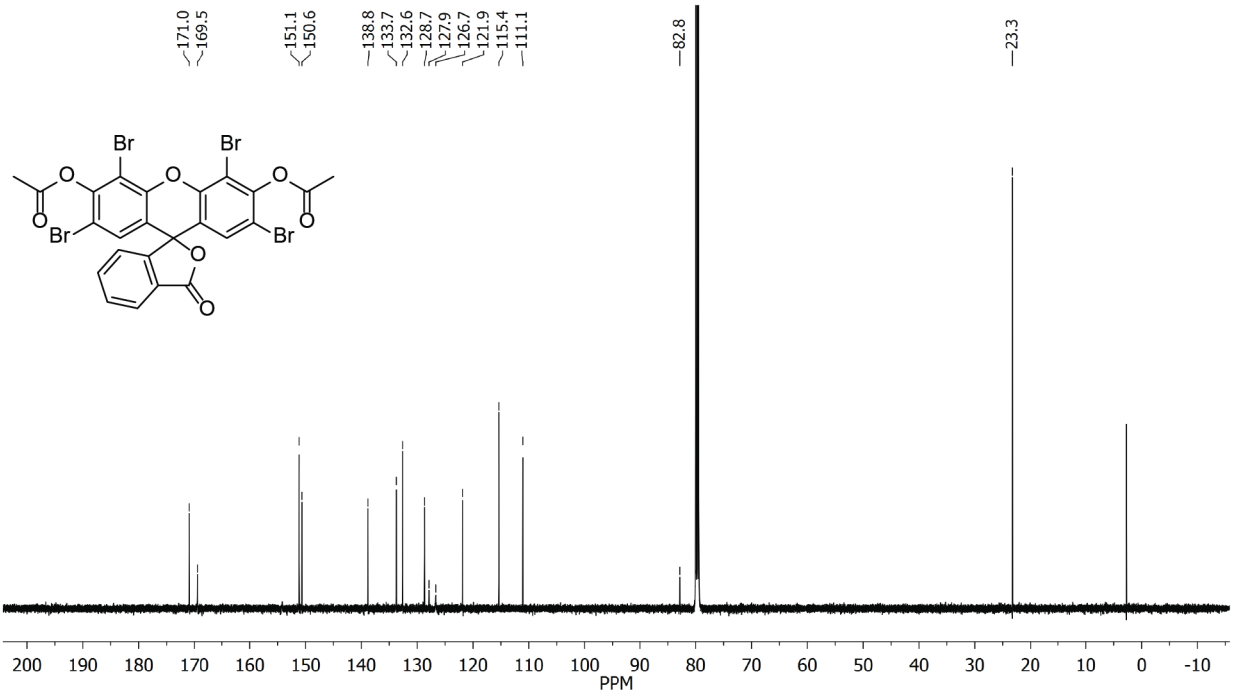
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **1c**



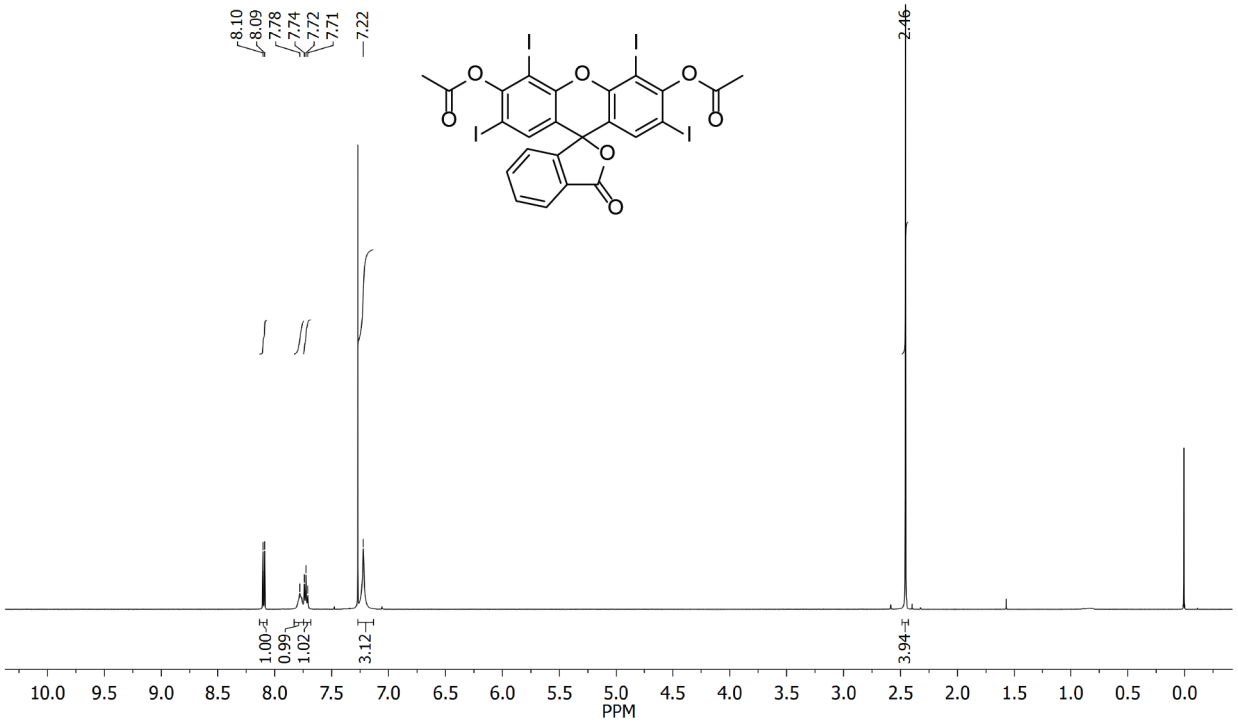


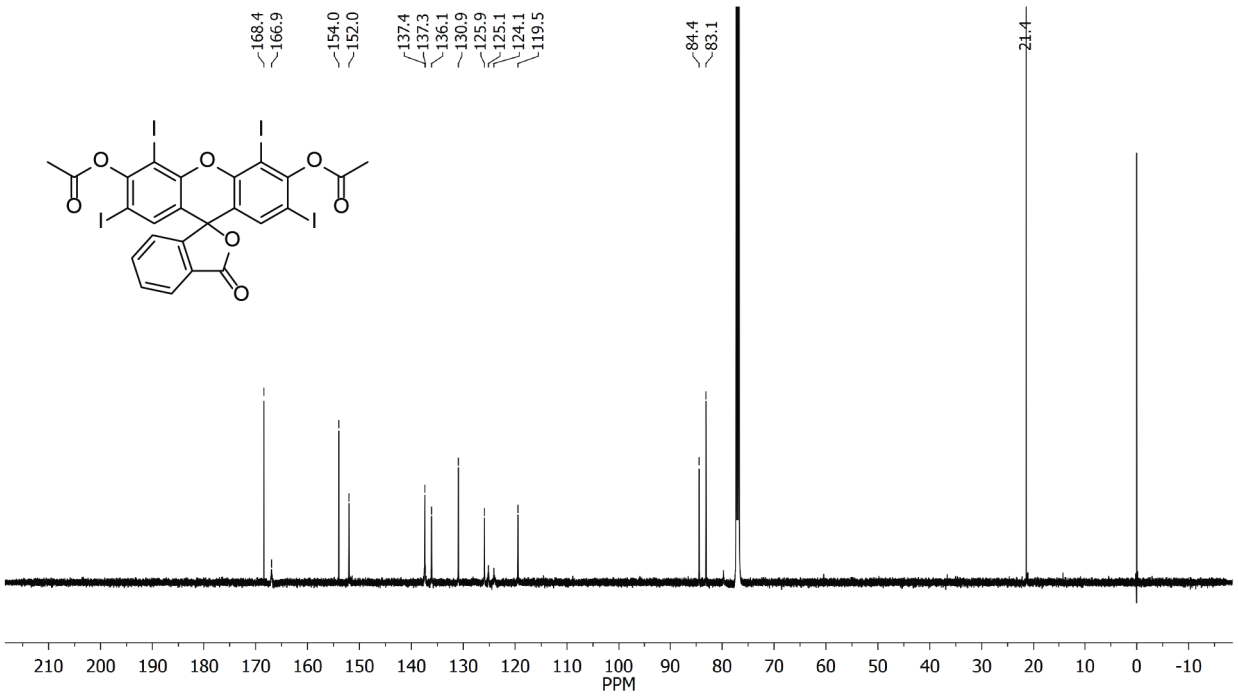
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **1d**



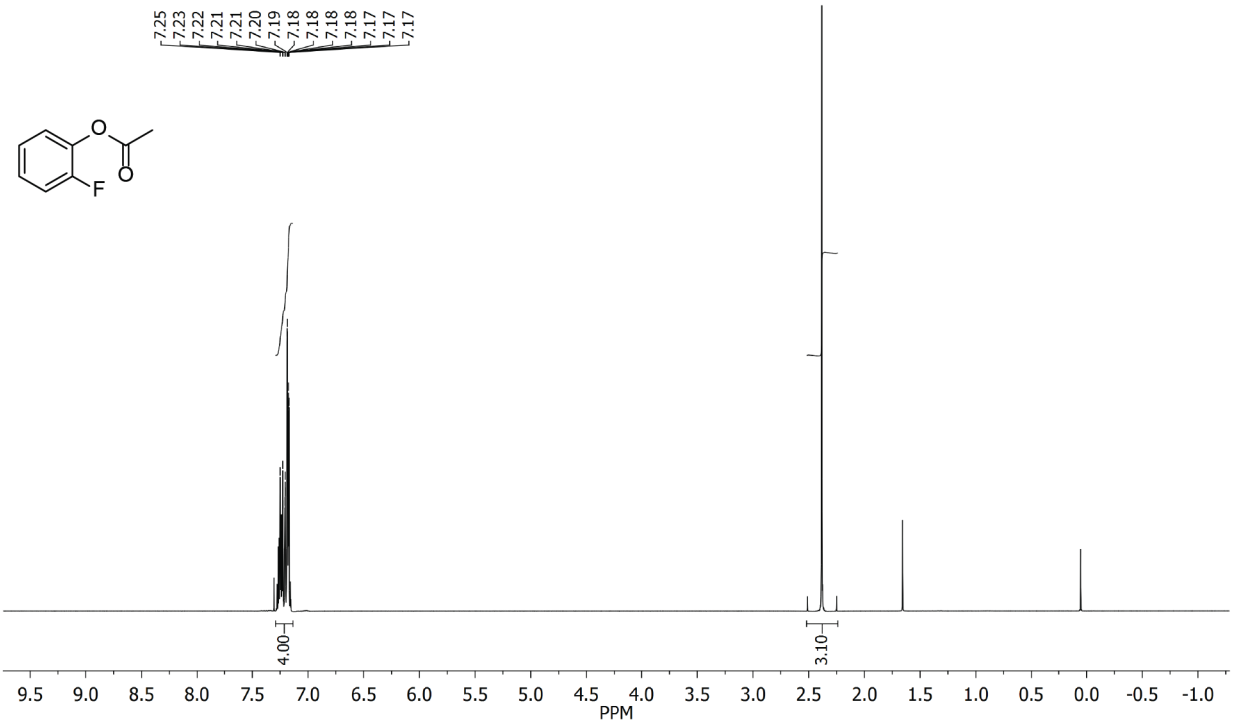


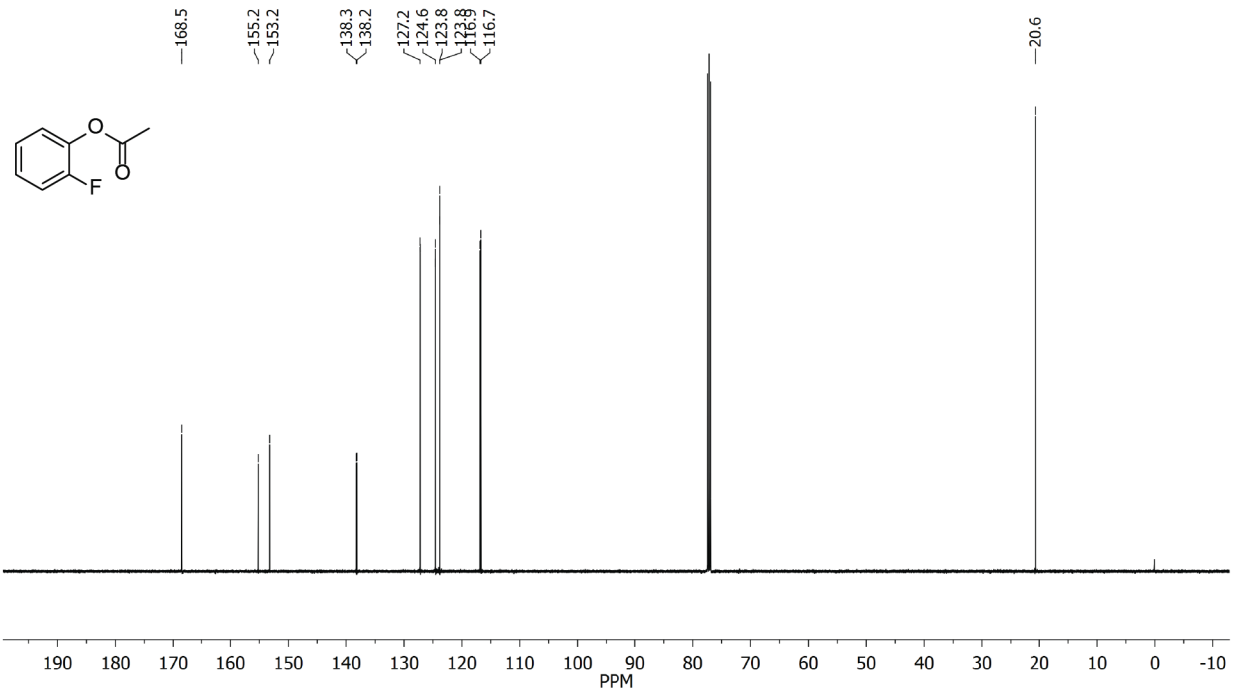
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **1e**



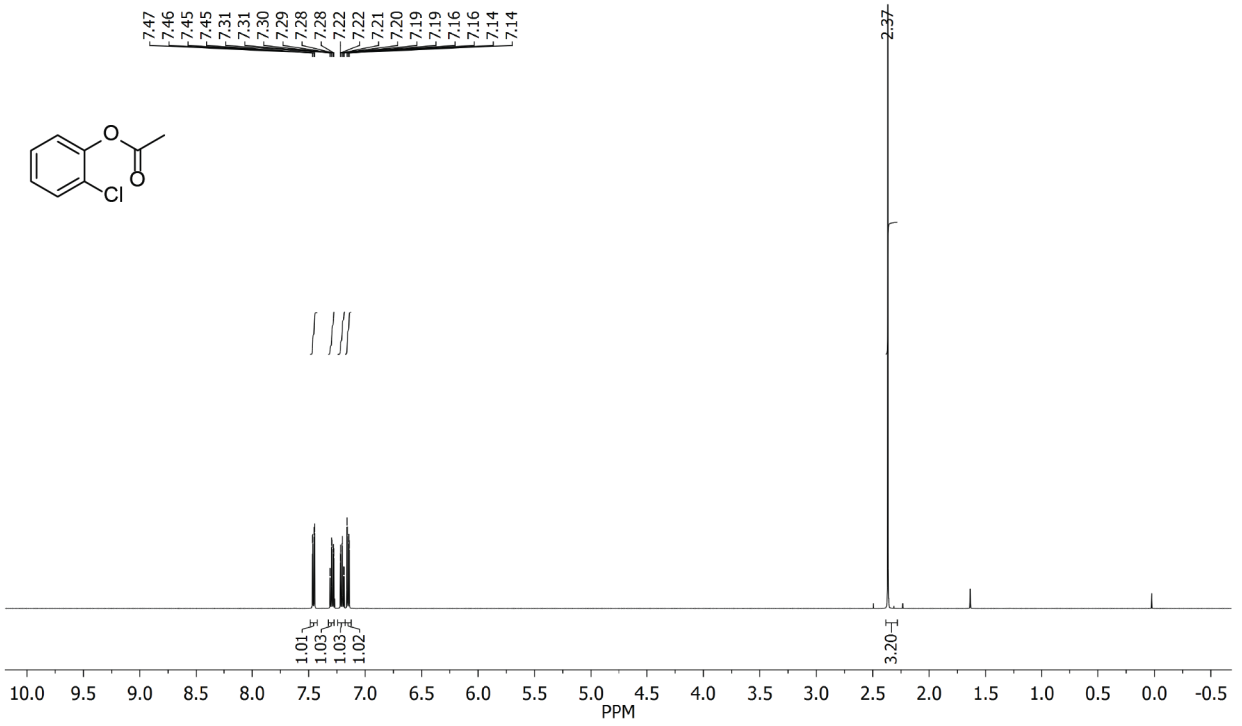


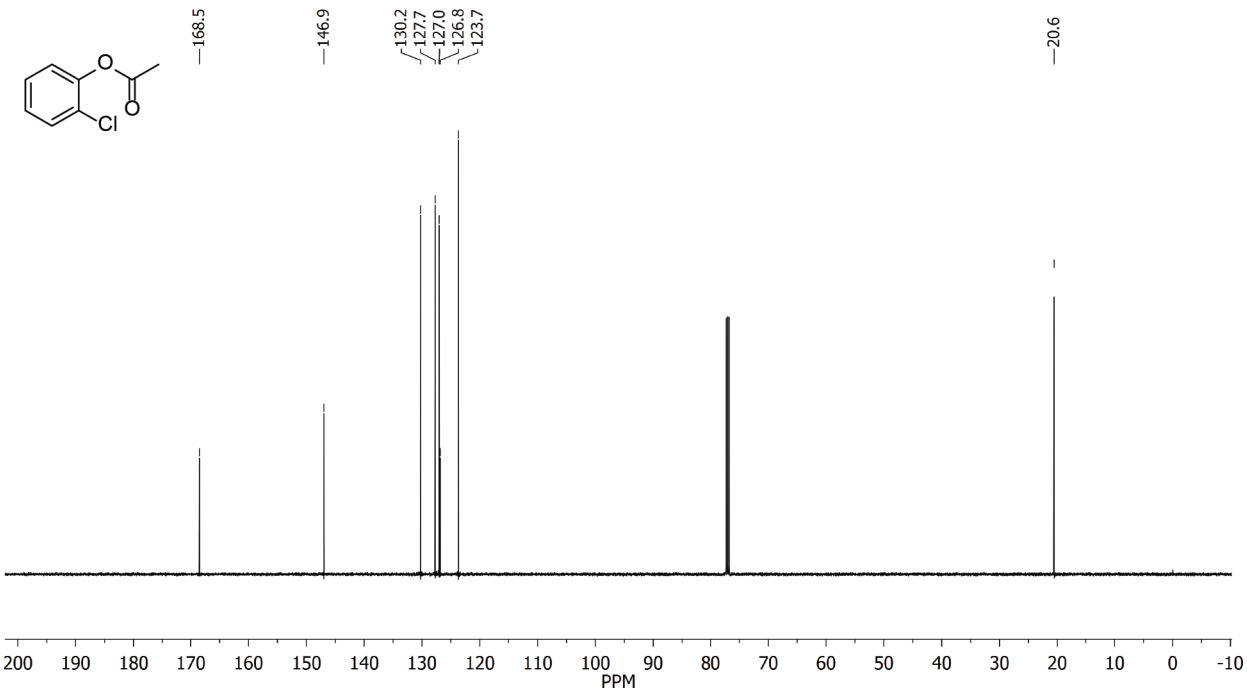
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **2b**



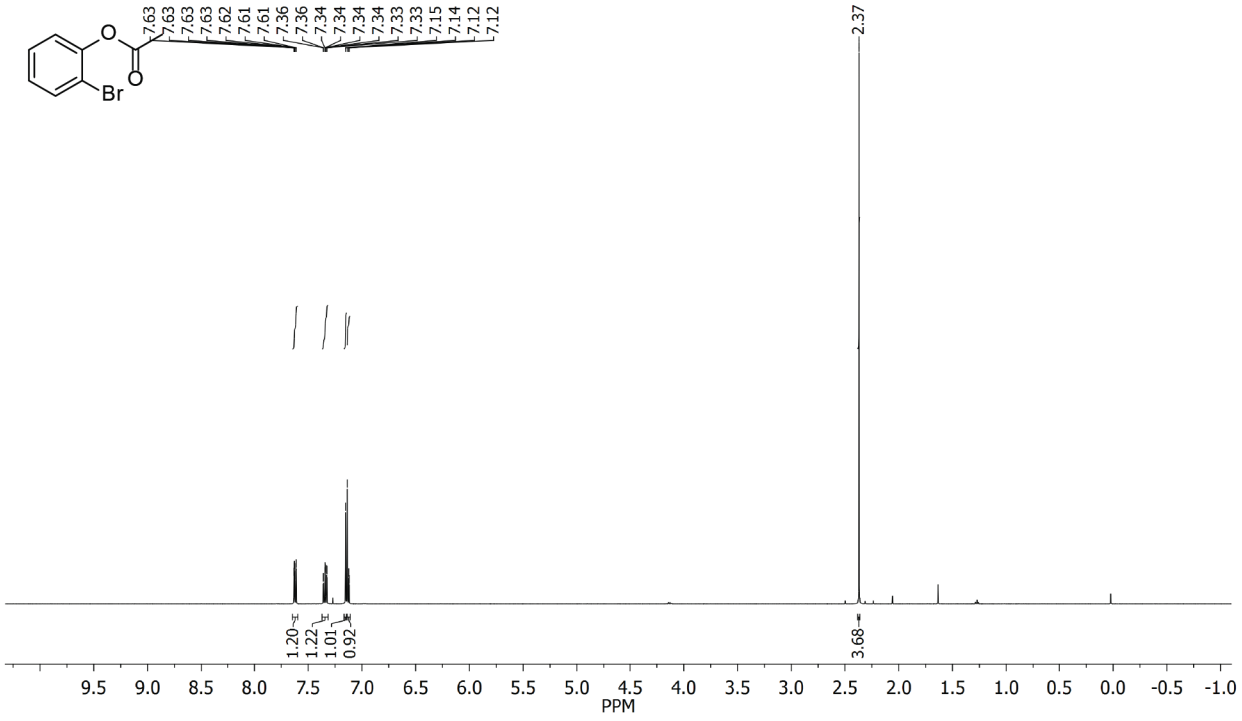


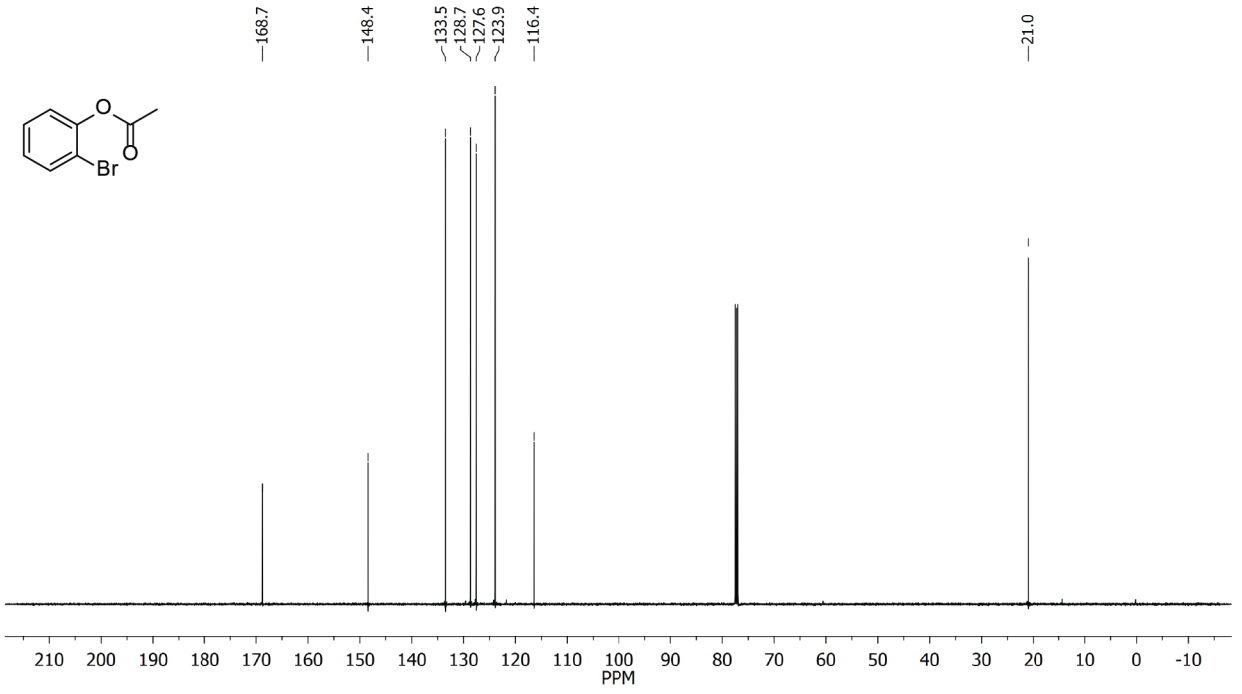
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **2c**



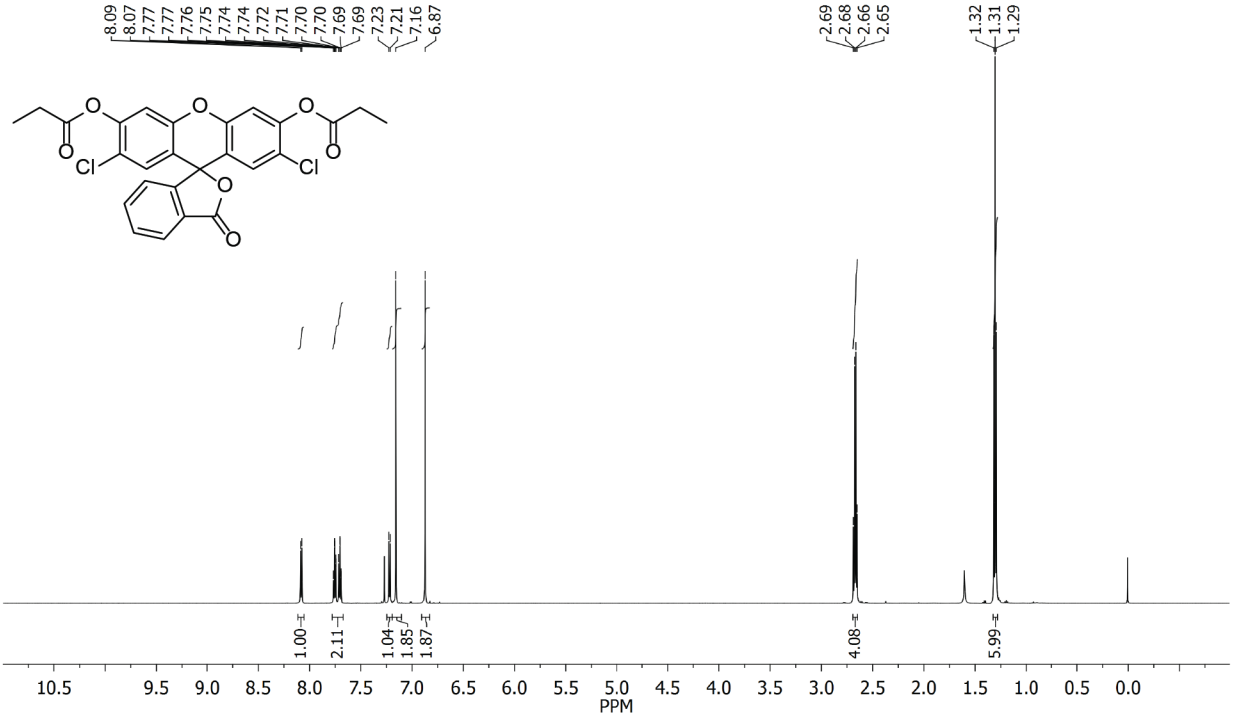


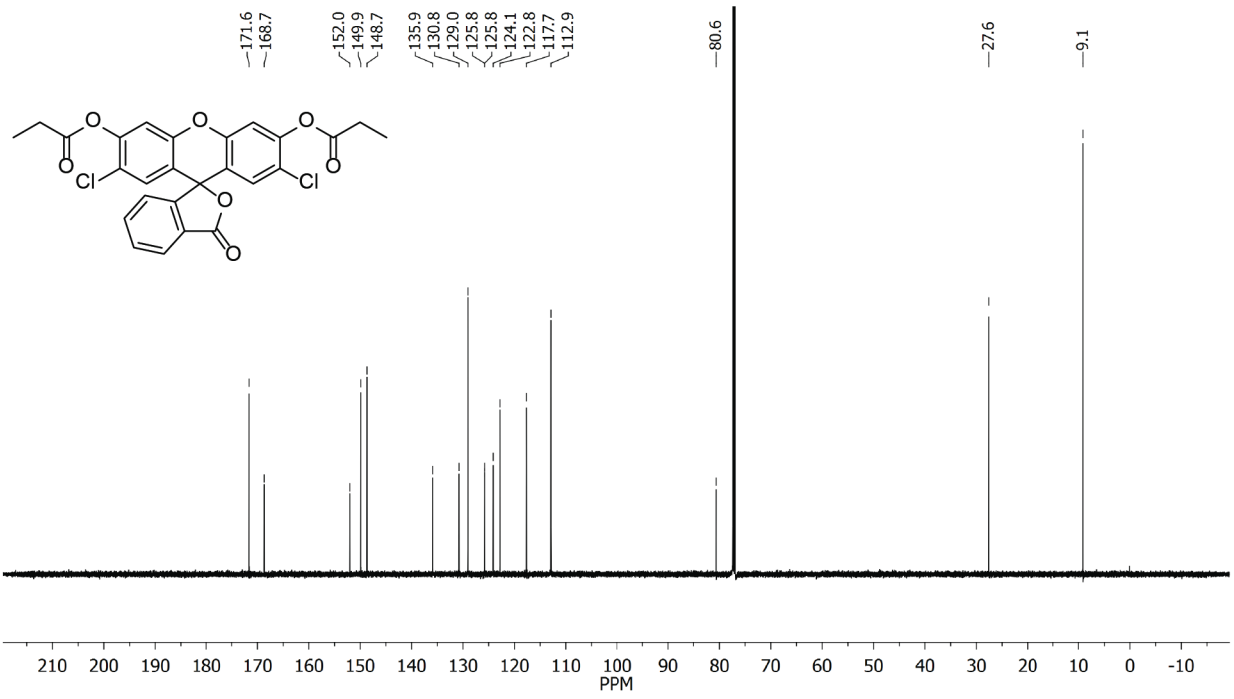
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **2d**



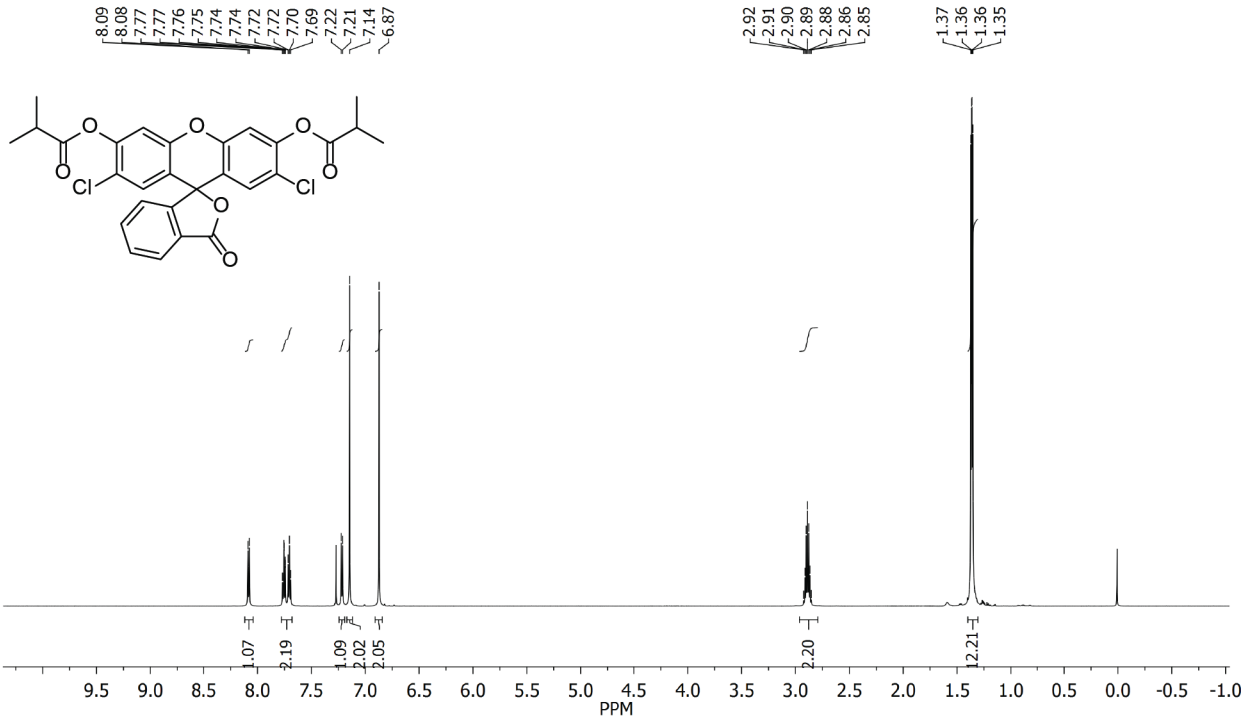


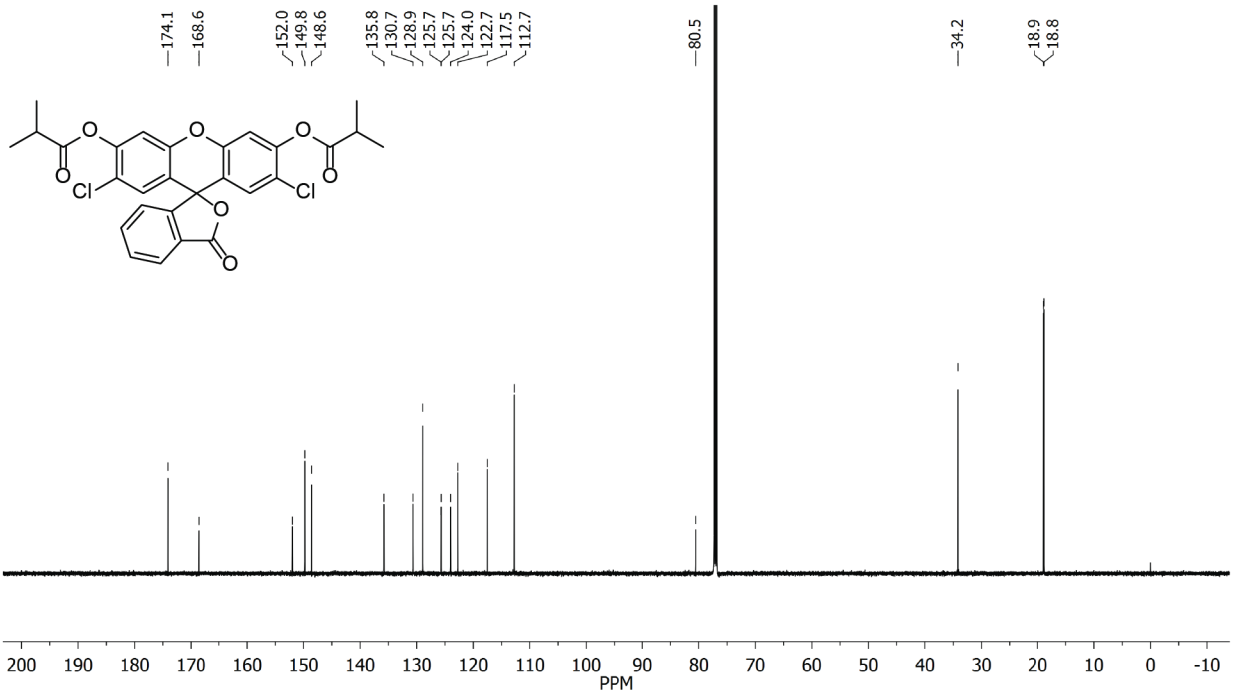
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **3a**



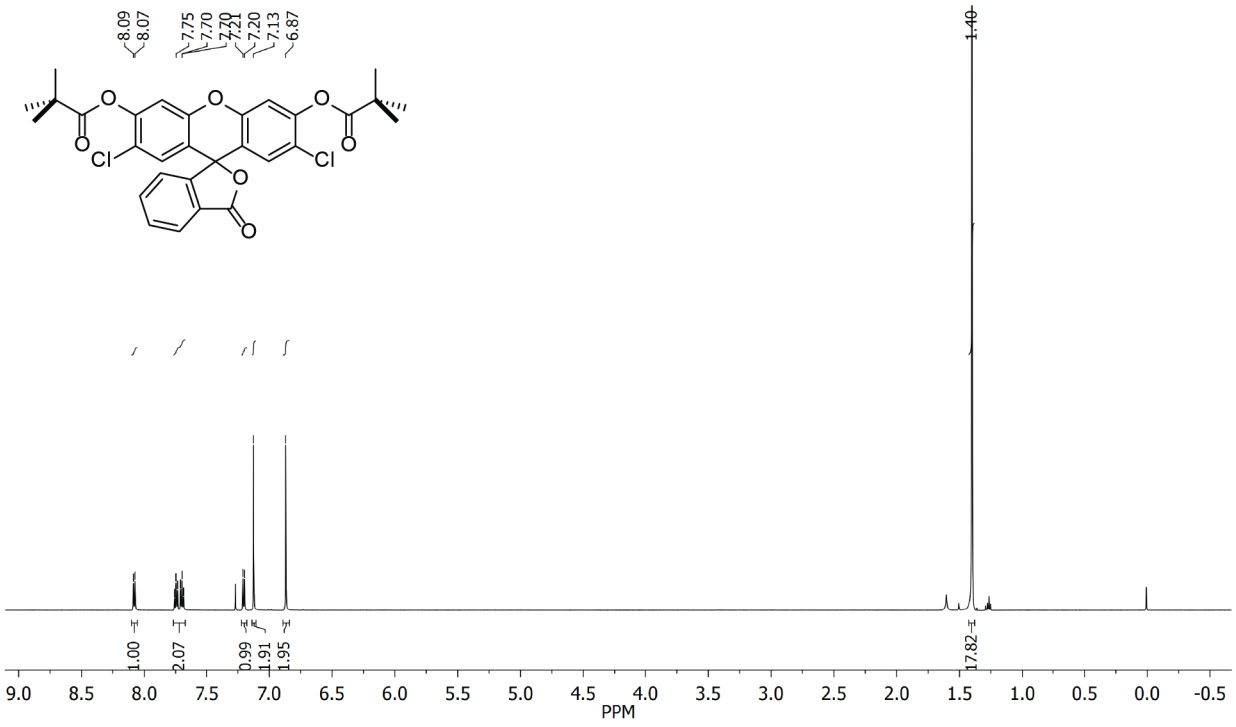


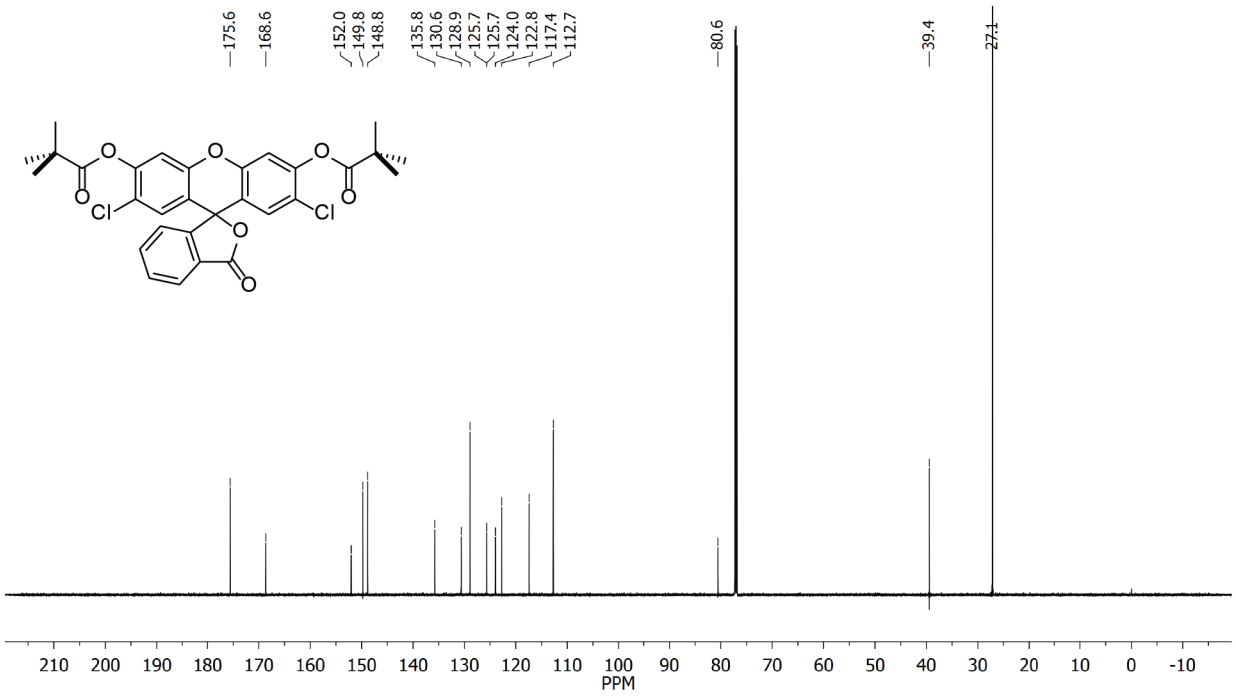
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **3b**



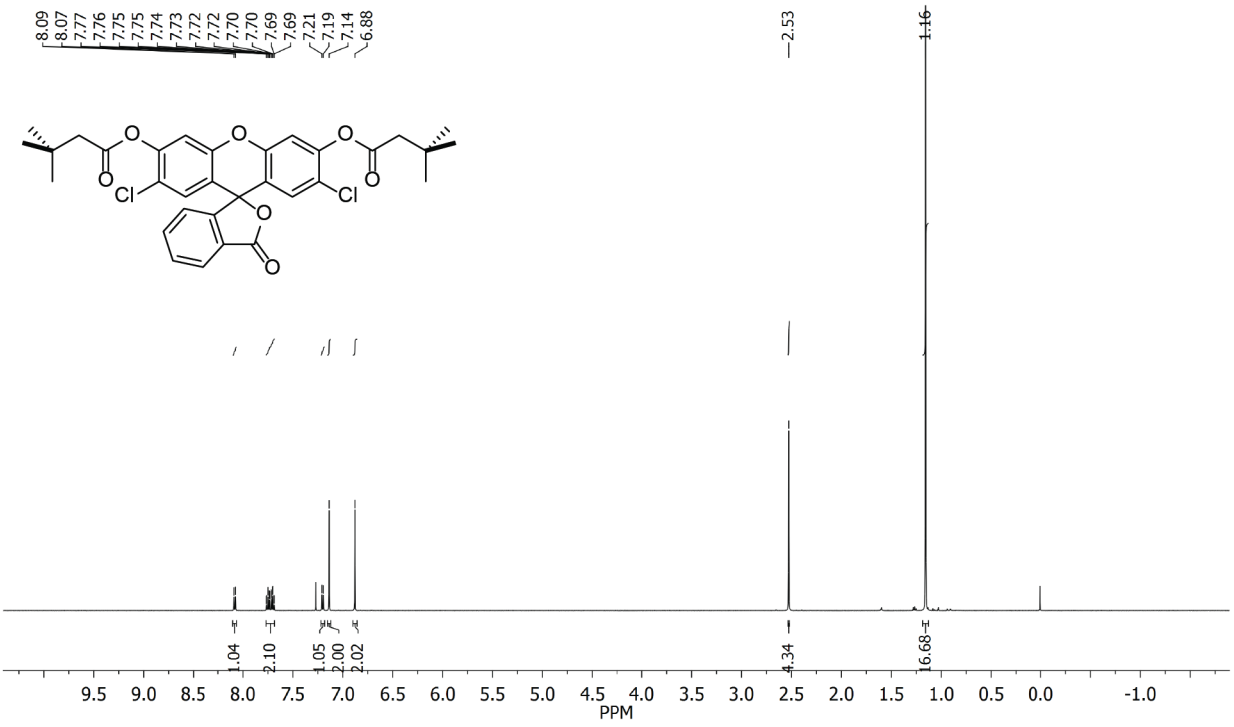


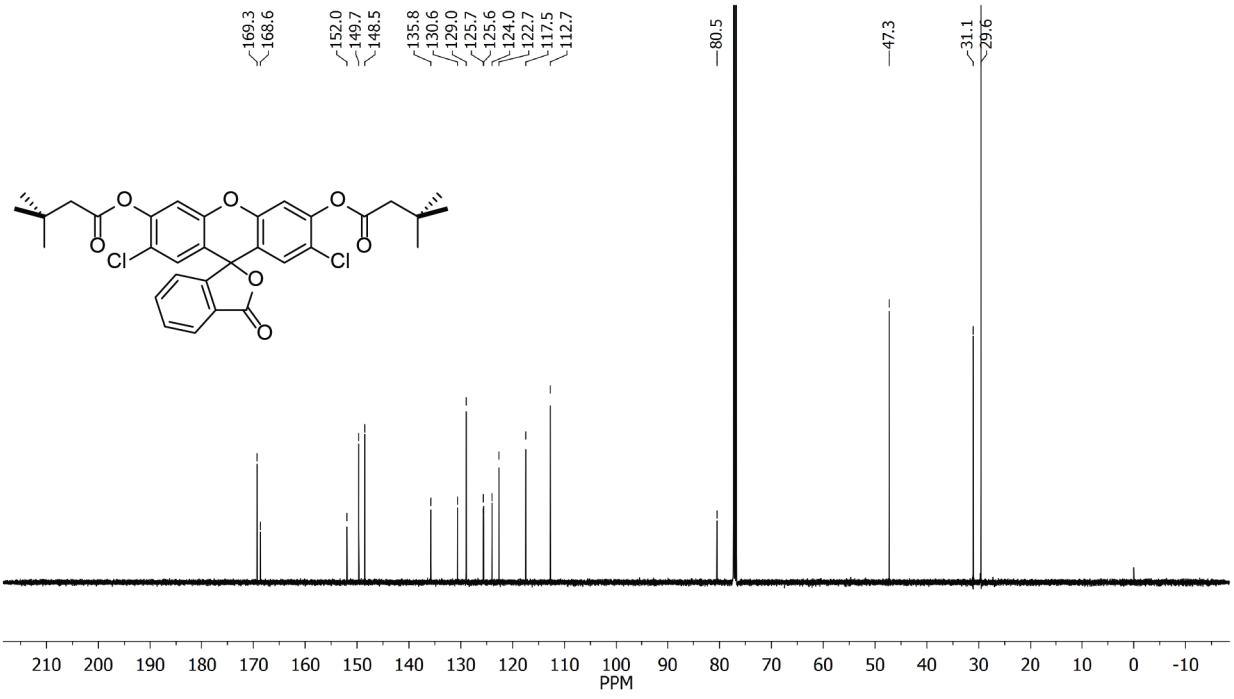
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **3c**



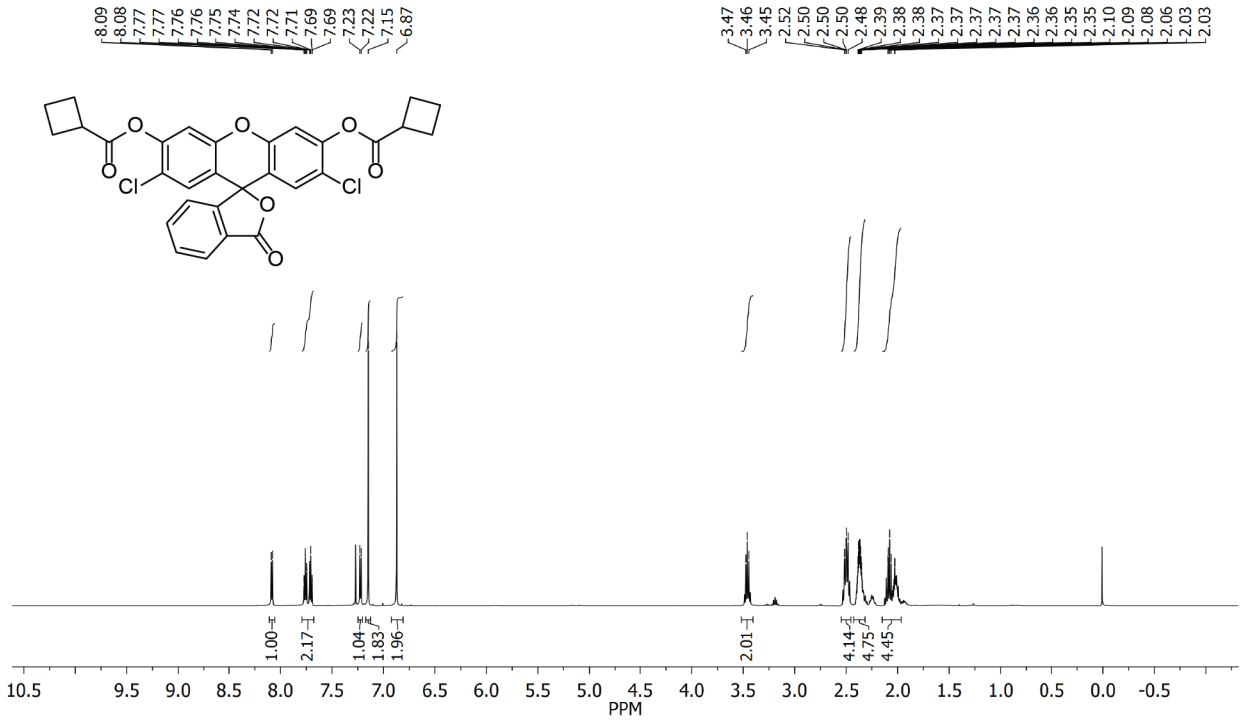


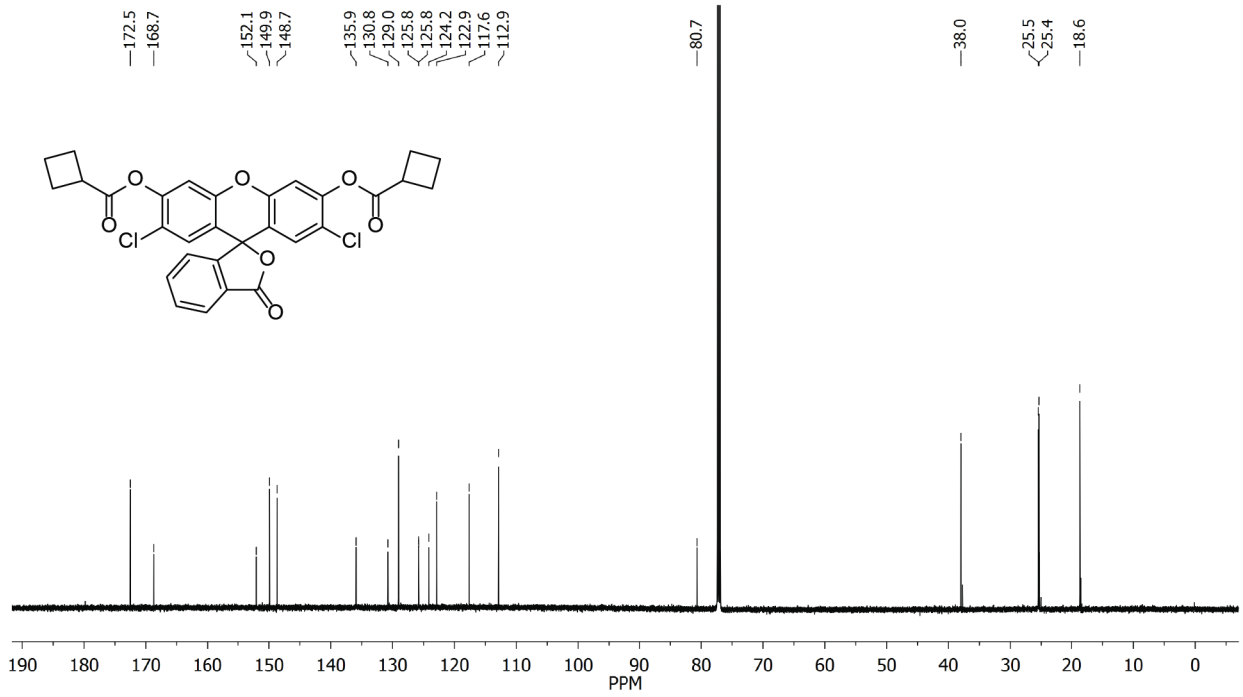
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **3d**



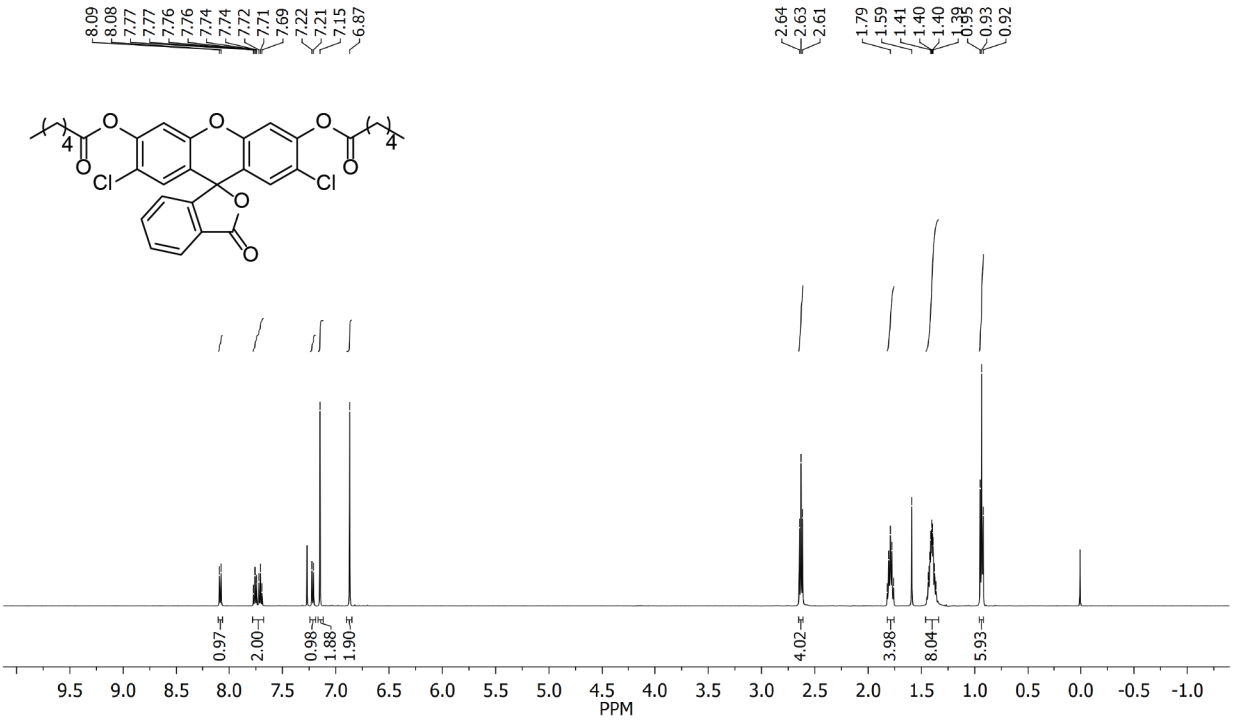


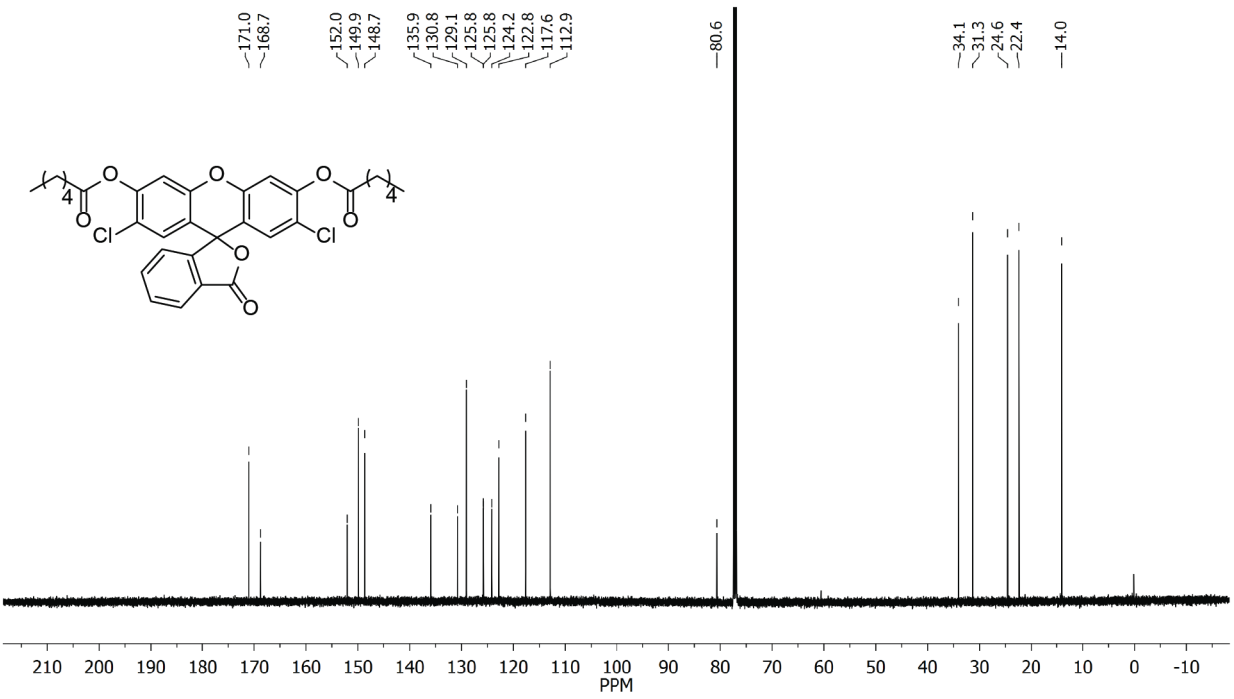
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **3e**



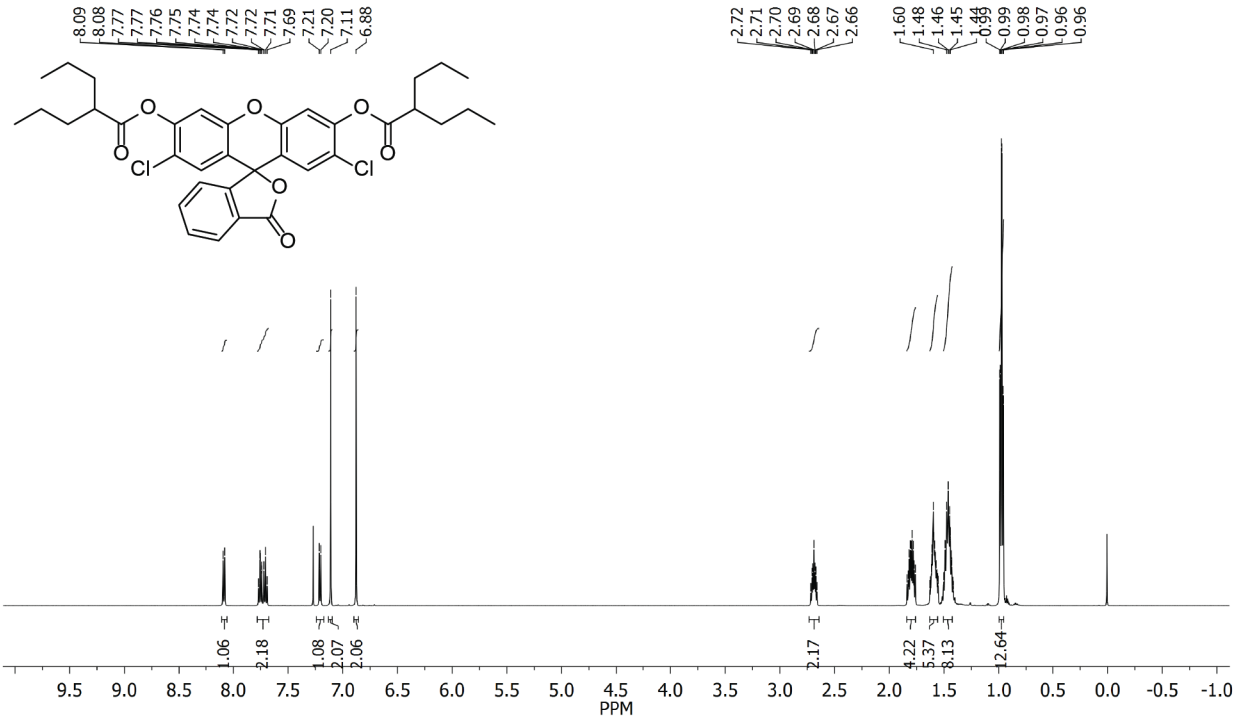


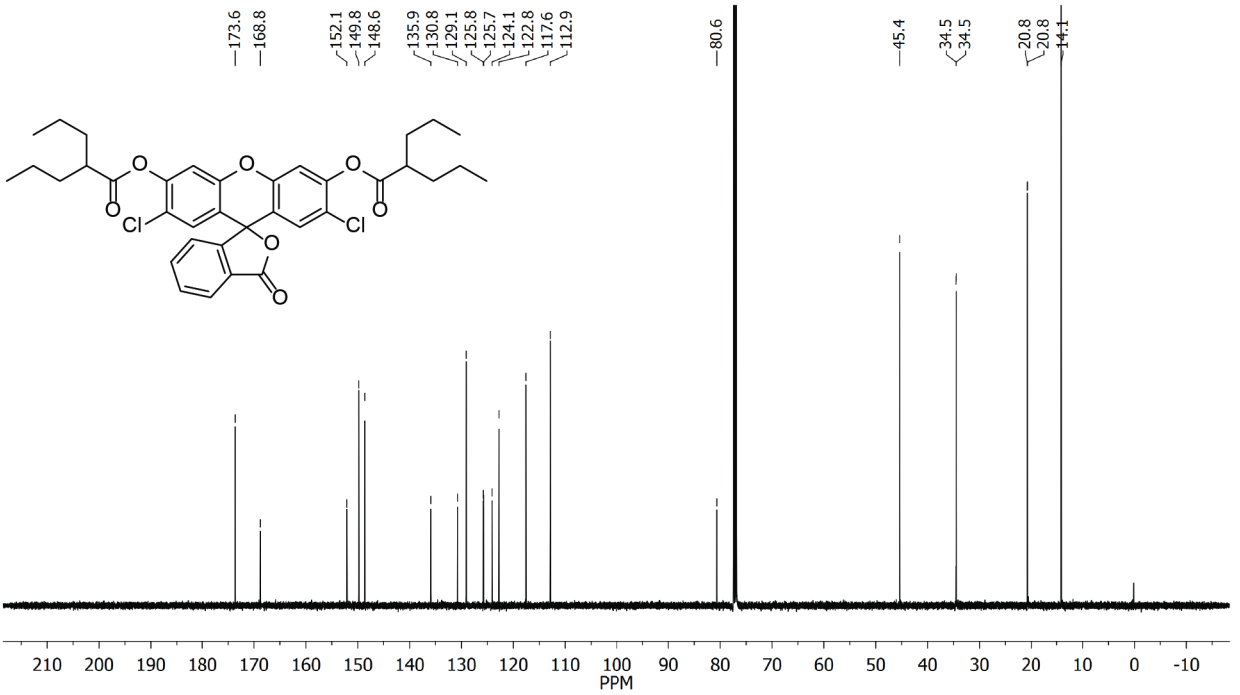
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **3f**



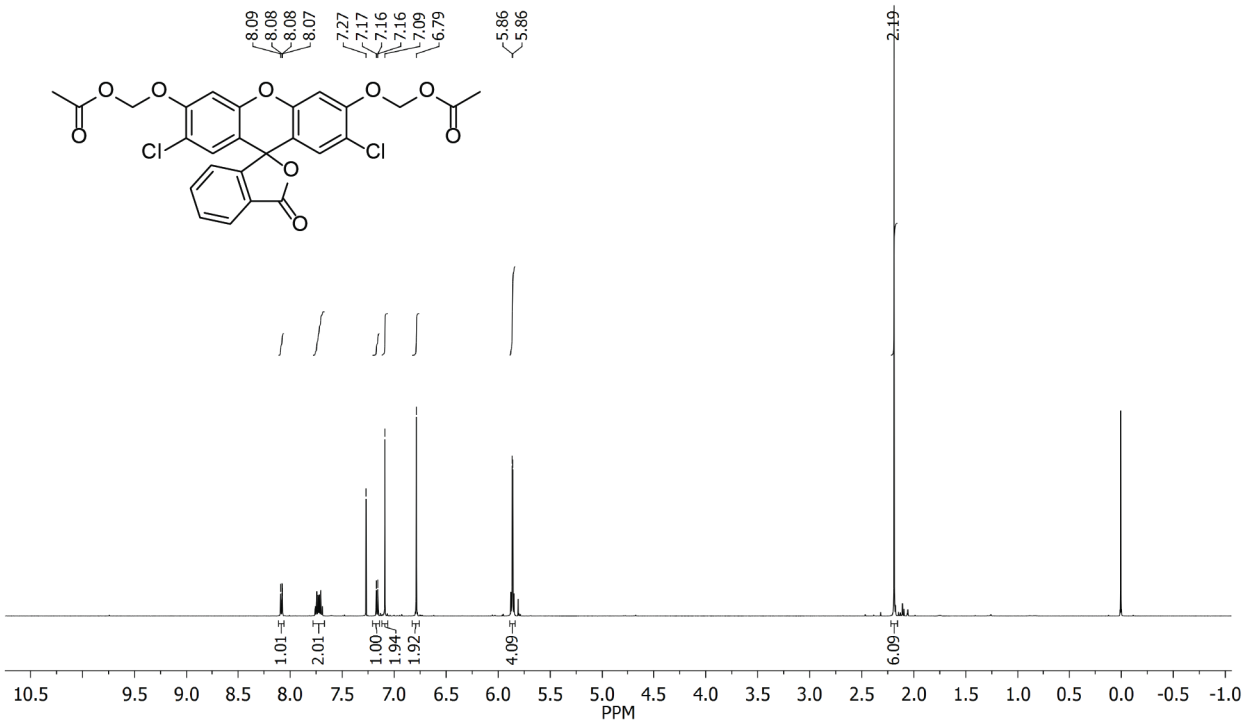


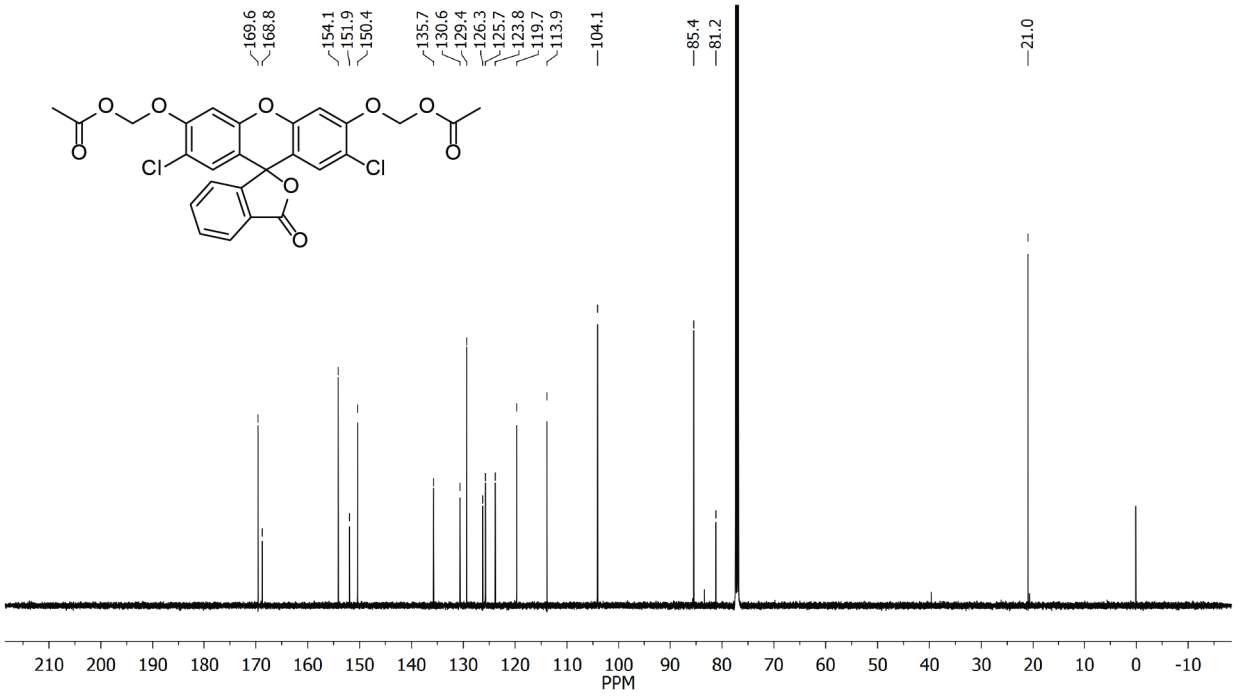
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **3g**





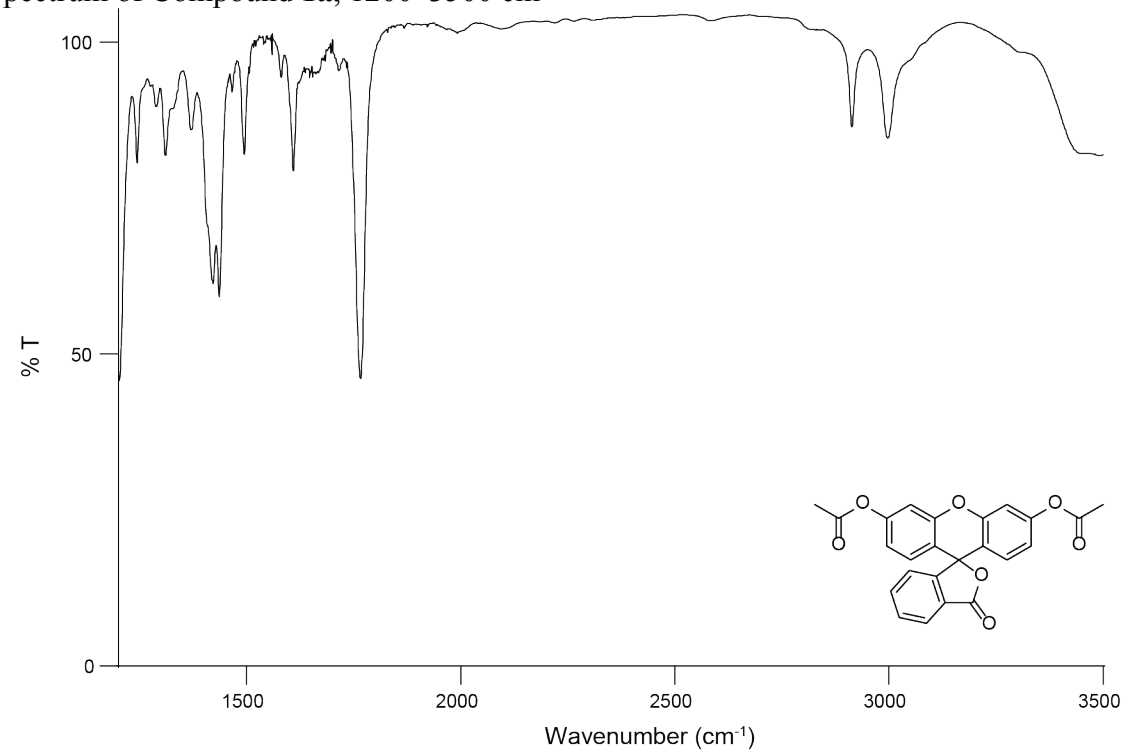
^{1}H NMR ($CDCl_3$) and ^{13}C NMR ($CDCl_3$) Spectra of Compound **AM**



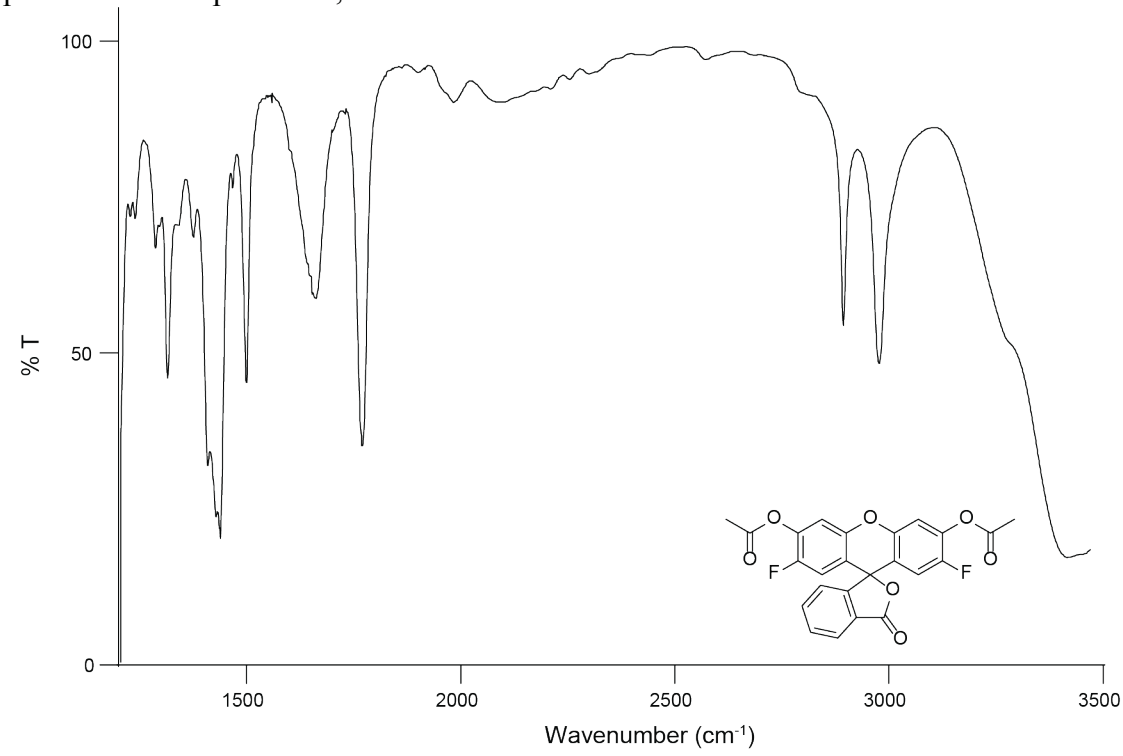


IR Spectra

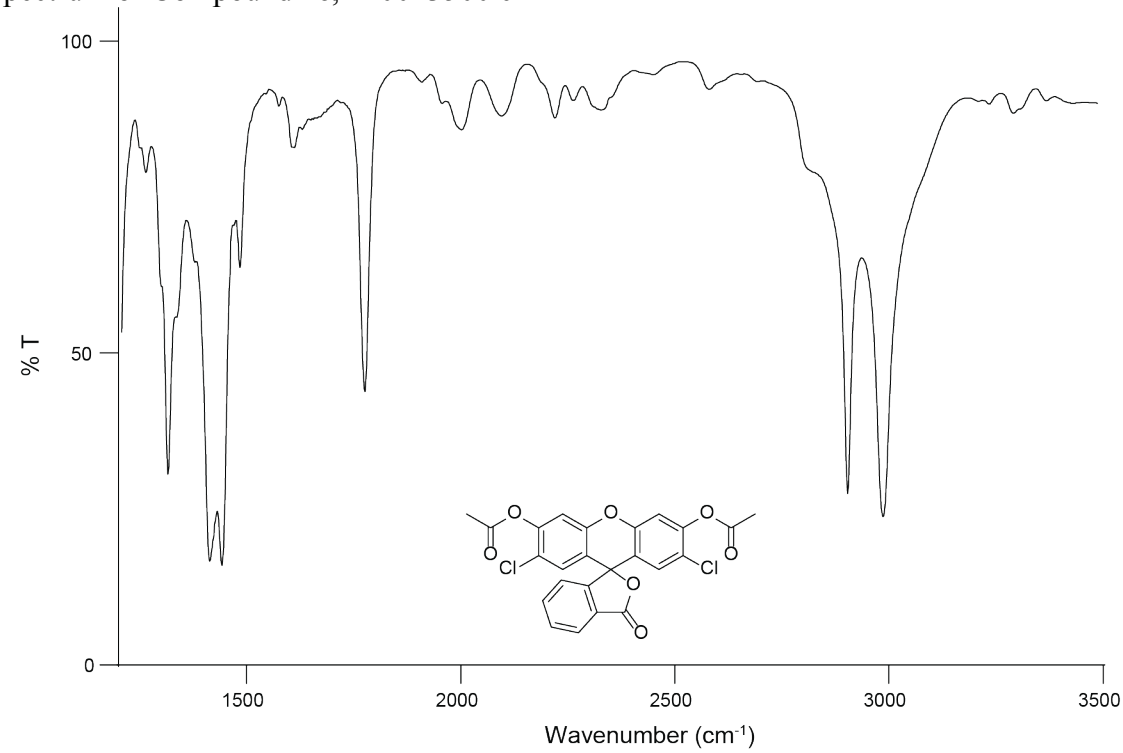
IR Spectrum of Compound **1a**, 1200–3500 cm^{-1}



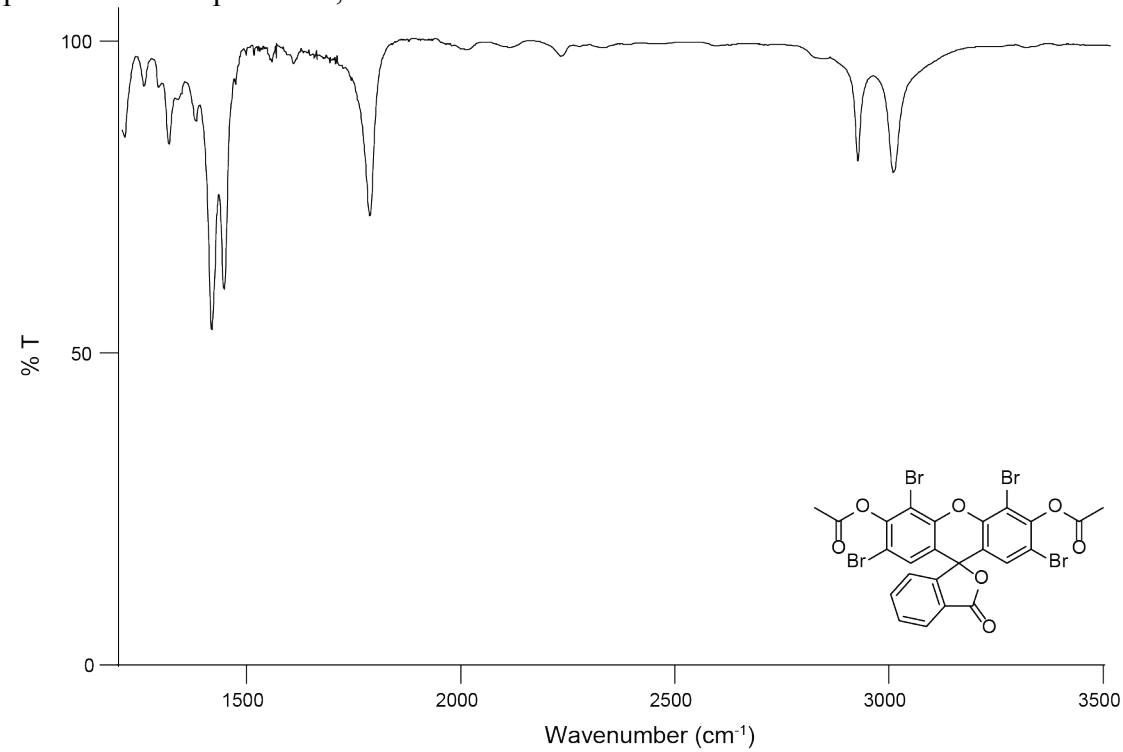
IR Spectrum of Compound **1b**, 1200–3500 cm^{-1}



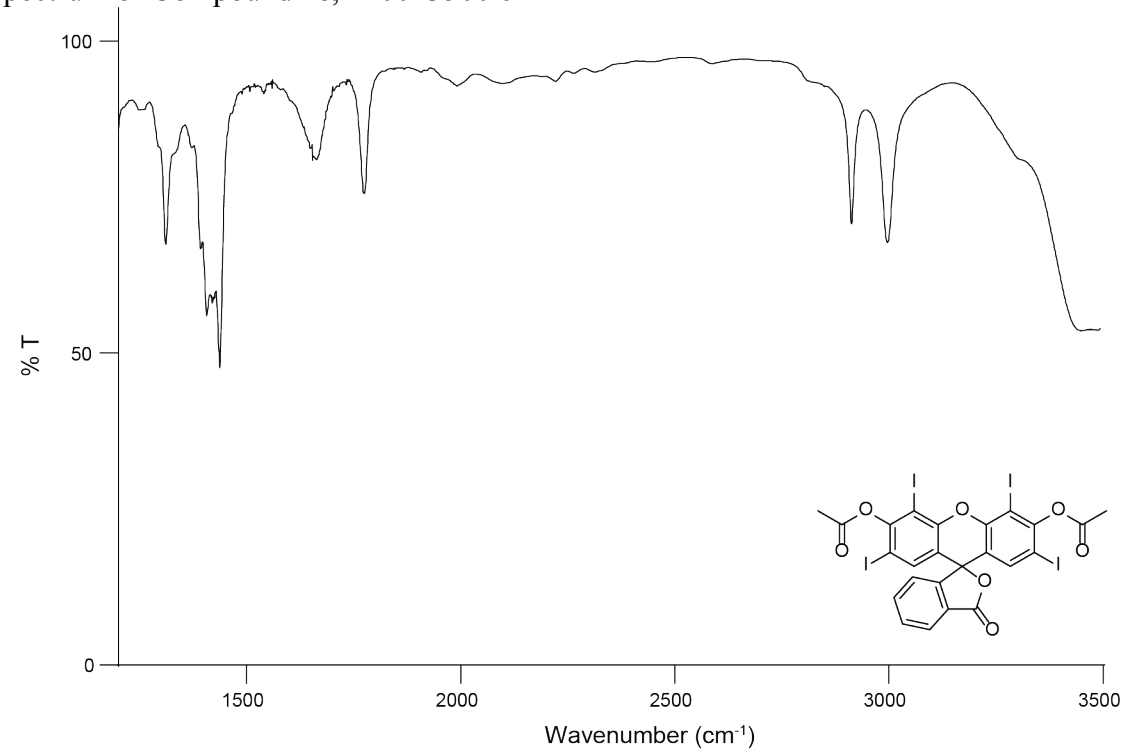
IR Spectrum of Compound **1c**, 1200–3500 cm^{-1}



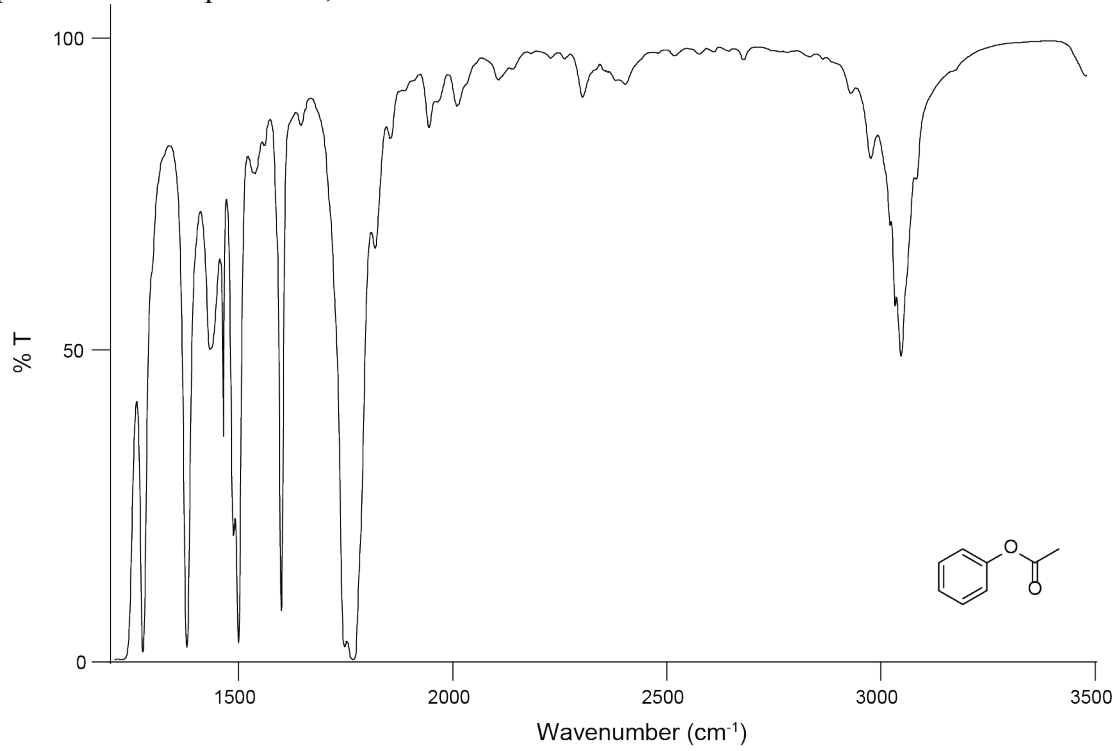
IR Spectrum of Compound **1d**, 1200–3500 cm^{-1}



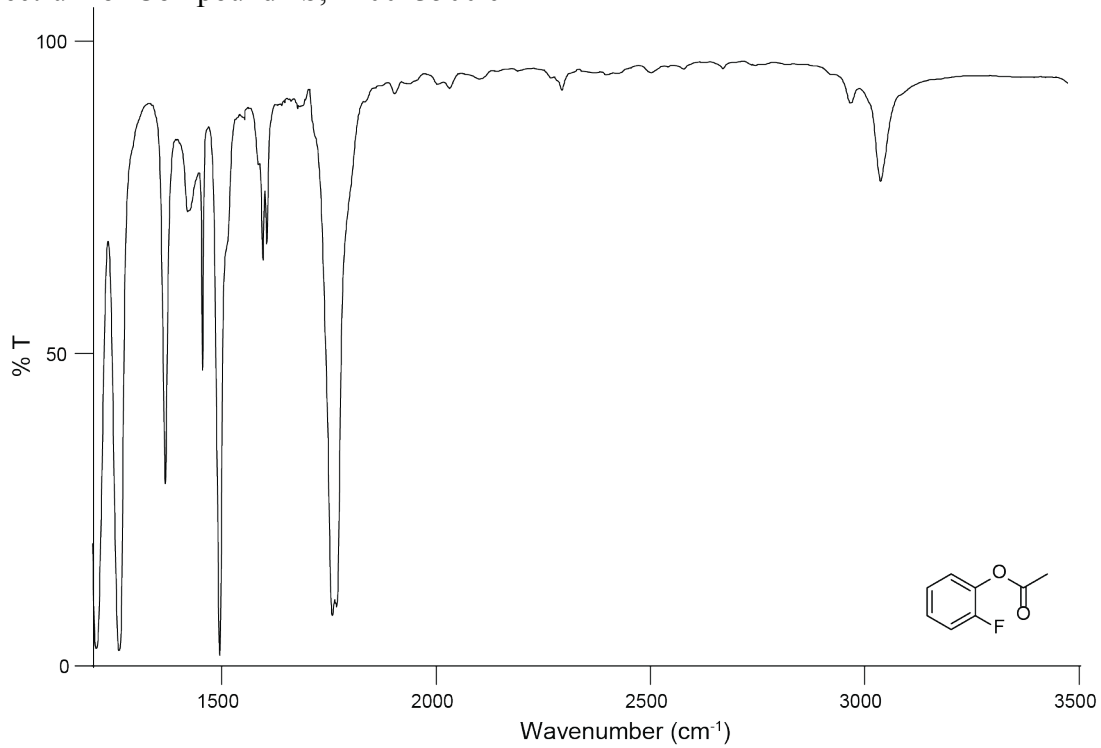
IR Spectrum of Compound **1e**, 1200–3500 cm^{-1}



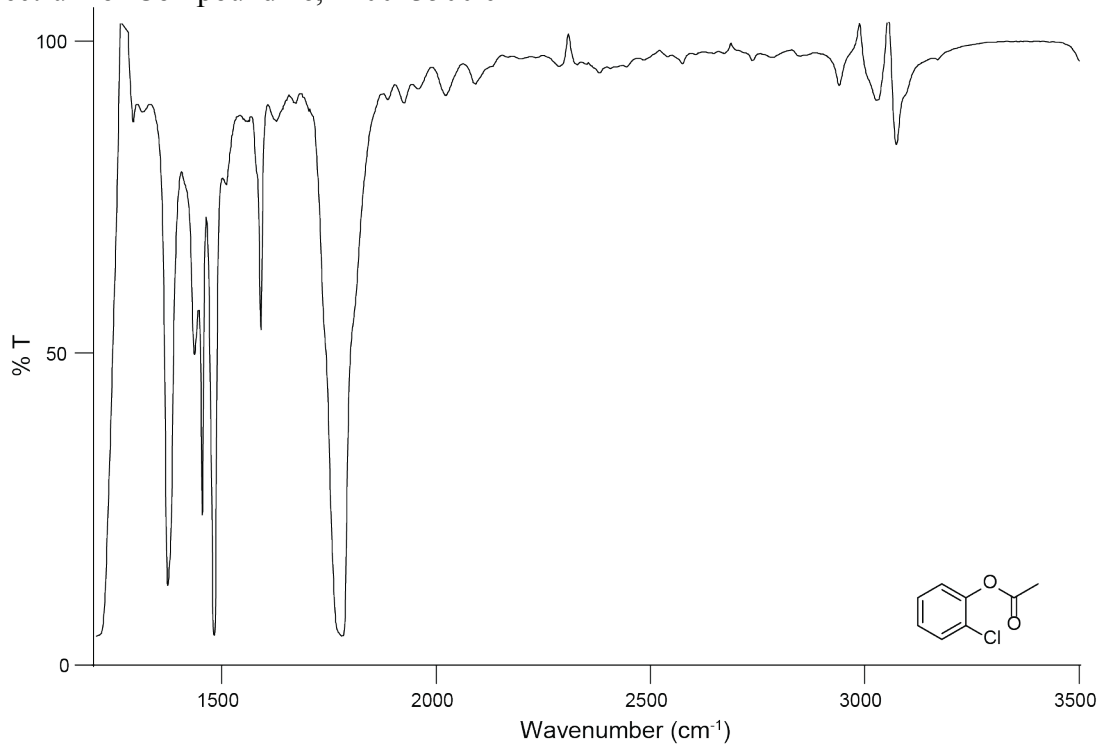
IR Spectrum of Compound **2a**, 1200–3500 cm^{-1}



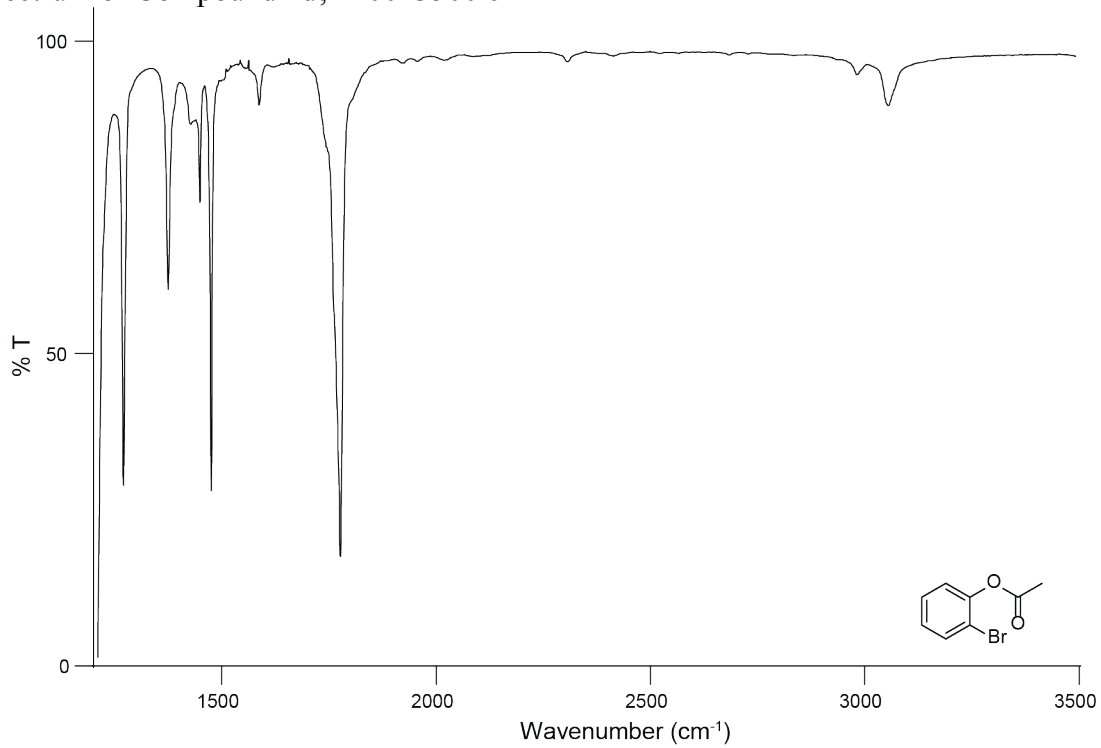
IR Spectrum of Compound **2b**, 1200–3500 cm^{-1}



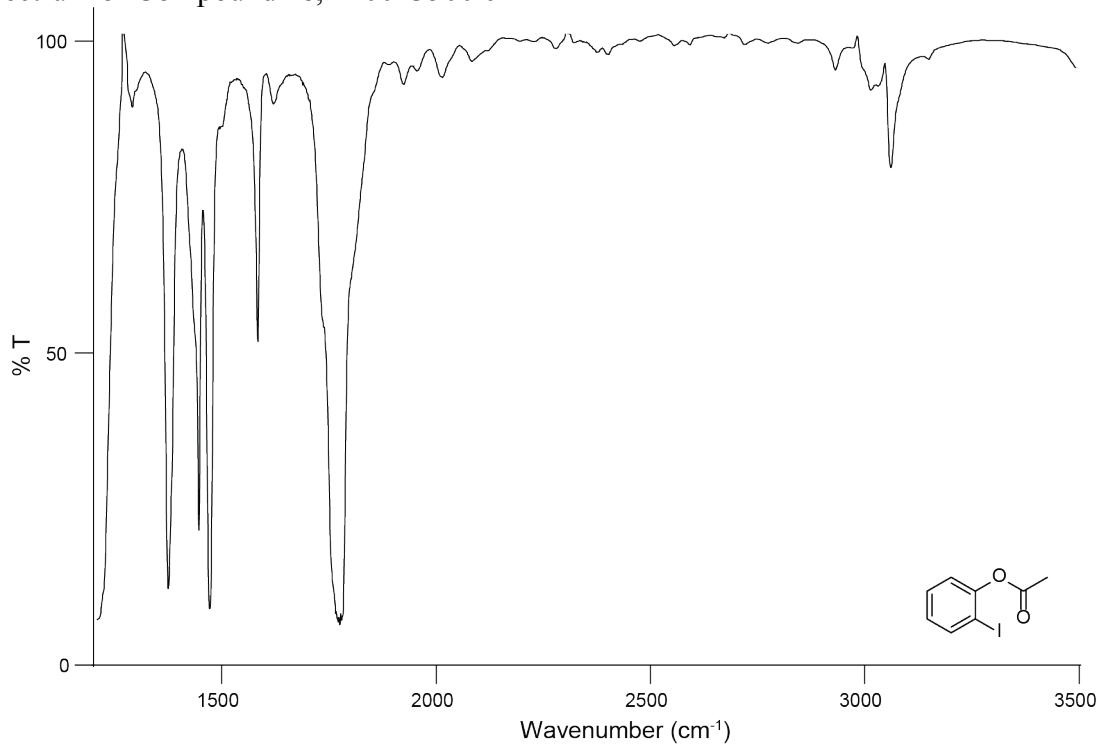
IR Spectrum of Compound **2c**, 1200–3500 cm^{-1}



IR Spectrum of Compound **2d**, 1200–3500 cm^{-1}



IR Spectrum of Compound **2e**, 1200–3500 cm^{-1}



Dihedral-Angle Scans

Dihedral-angle scan of compound **2a,** Figure 3A.

d	*ω*	*E* - E_o	*E* (Hartrees)
3.293	130.348	2.4920	-460.0649
3.337	130.830	2.4881	-460.0649
3.377	130.173	2.4584	-460.0650
3.417	129.850	2.4848	-460.0649
3.455	130.060	2.5527	-460.0648
3.493	130.137	2.6428	-460.0647
3.532	130.265	2.7396	-460.0645
3.568	130.370	2.8440	-460.0644
3.603	130.253	2.9622	-460.0642
3.635	130.017	3.0943	-460.0640
3.666	129.816	3.2527	-460.0637
3.696	129.216	3.4341	-460.0634
3.723	128.880	3.6416	-460.0631
3.748	128.499	3.8806	-460.0627
3.771	127.927	4.1439	-460.0623
3.792	127.143	4.4226	-460.0619
3.809	125.971	4.7052	-460.0614
3.825	125.197	5.0035	-460.0609
3.839	124.485	5.3275	-460.0604
3.852	123.784	5.6767	-460.0599
3.863	122.953	6.0458	-460.0593
3.87	121.752	6.4231	-460.0587
3.875	120.497	6.8006	-460.0581
3.879	119.232	7.1848	-460.0574
3.881	117.981	7.5794	-460.0568
3.881	116.693	7.9885	-460.0562
3.88	115.410	8.4077	-460.0555
3.877	114.053	8.8259	-460.0548
3.87	112.514	9.2279	-460.0542
3.819	123.599	1.9130	-460.0659
3.813	122.209	1.7307	-460.0661
3.805	120.718	1.5436	-460.0664
3.795	119.118	1.3529	-460.0667
3.782	117.551	1.1656	-460.0670
3.767	116.121	0.9912	-460.0673
3.75	114.454	0.8314	-460.0676
3.73	112.551	0.6727	-460.0678
3.707	111.063	0.5387	-460.0680
3.68	109.653	0.4268	-460.0682
3.652	108.180	0.3363	-460.0684
3.622	106.613	0.2657	-460.0685

3.589	105.113	0.2116	-460.0686
3.553	103.647	0.1690	-460.0686
3.517	101.629	0.1174	-460.0687
3.478	99.978	0.0686	-460.0688
3.439	98.109	0.0305	-460.0689
3.399	96.117	0.0070	-460.0689
3.357	93.917	0.0152	-460.0689
3.312	92.105	0.0544	-460.0688
3.266	90.547	0.0819	-460.0688
3.218	88.434	0.0685	-460.0688
3.171	86.798	0.0326	-460.0688
3.128	84.731	0.0000	-460.0689
3.087	82.750	0.0229	-460.0689
3.046	79.949	0.0543	-460.0688
3.005	77.935	0.1032	-460.0687
2.966	75.911	0.1548	-460.0687
2.929	73.637	0.2035	-460.0686
2.895	71.811	0.2586	-460.0685
2.868	69.945	0.3303	-460.0684
2.84	68.064	0.4225	-460.0682
2.817	66.280	0.5369	-460.0680
2.799	64.556	0.6733	-460.0678
2.788	62.816	0.8295	-460.0676
2.78	60.988	0.9980	-460.0673
2.774	59.174	1.1641	-460.0670
2.771	57.680	1.3434	-460.0668
2.769	56.172	1.5227	-460.0665
2.769	54.759	1.6961	-460.0662
2.771	53.476	1.8625	-460.0659
2.774	52.242	2.0176	-460.0657
2.777	51.166	2.1554	-460.0655
2.785	49.963	2.2665	-460.0653
2.788	49.299	2.3247	-460.0652
2.79	49.023	2.3529	-460.0651
2.792	49.047	2.3550	-460.0651
2.789	49.248	2.3307	-460.0652
2.786	49.826	2.2777	-460.0653
2.778	51.002	2.1743	-460.0654
2.774	52.067	2.0394	-460.0656
2.771	53.297	1.8866	-460.0659
2.769	54.562	1.7215	-460.0662
2.769	55.954	1.5491	-460.0664
2.77	57.456	1.3704	-460.0667
2.773	58.963	1.1906	-460.0670
2.78	60.430	1.0184	-460.0673
2.789	62.143	0.8577	-460.0675
2.797	64.281	0.6957	-460.0678

2.814	66.013	0.5559	-460.0680
2.837	67.792	0.4381	-460.0682
2.863	69.661	0.3428	-460.0684
2.891	71.556	0.2681	-460.0685
2.924	73.381	0.2108	-460.0686
2.961	75.259	0.1664	-460.0686
2.999	77.626	0.1110	-460.0687
3.039	79.664	0.0607	-460.0688
3.08	81.892	0.0229	-460.0689
3.121	83.990	0.0090	-460.0689
3.165	86.488	0.0262	-460.0689
3.211	88.200	0.0635	-460.0688
3.259	89.757	0.0857	-460.0688

Dihedral-angle scan of compound **2b,** Figure 3B.

d	ω	$E - E_\circ$	E (Hartrees)
2.995	78.425	0.0000	-559.3075
2.959	76.755	0.0445	-559.3075
2.927	74.900	0.1249	-559.3073
2.894	73.589	0.2674	-559.3071
2.866	72.627	0.4653	-559.3068
2.845	71.814	0.7330	-559.3064
2.831	71.091	1.0780	-559.3058
2.820	70.375	1.5001	-559.3051
2.812	69.622	1.9902	-559.3044
2.807	68.908	2.5356	-559.3035
2.806	68.173	3.1305	-559.3025
2.808	67.450	3.7696	-559.3015
2.811	66.723	4.4450	-559.3004
2.817	65.970	5.1453	-559.2993
2.825	65.266	5.8560	-559.2982
2.834	64.595	6.5632	-559.2971
2.846	63.869	7.2604	-559.2960
2.866	62.801	7.9396	-559.2949
2.890	61.714	8.5917	-559.2938
2.915	60.616	9.2107	-559.2928
2.958	58.839	9.7684	-559.2920
2.891	61.639	8.6453	-559.2938
2.869	62.689	7.9957	-559.2948
2.848	63.790	7.3185	-559.2959
2.835	64.543	6.6224	-559.2970
2.826	65.210	5.9160	-559.2981
2.818	65.909	5.2051	-559.2992
2.812	66.666	4.5033	-559.3004

2.808	67.391	3.8253	-559.3014
2.806	68.120	3.1828	-559.3025
2.807	68.845	2.5839	-559.3034
2.812	69.556	2.0342	-559.3043
2.819	70.305	1.5390	-559.3051
2.830	71.034	1.1107	-559.3058
2.844	71.761	0.7591	-559.3063
2.864	72.564	0.4850	-559.3068
2.891	73.494	0.2817	-559.3071
2.924	74.790	0.1349	-559.3073
2.958	76.248	0.0422	-559.3075
2.993	77.857	0.0068	-559.3075
3.030	79.805	0.0253	-559.3075
3.072	81.729	0.1204	-559.3073
3.124	83.991	0.2346	-559.3072
3.178	85.620	0.3457	-559.3070
3.234	87.422	0.4503	-559.3068
3.290	89.351	0.5357	-559.3067
3.344	91.866	0.5708	-559.3066
3.395	94.266	0.6215	-559.3065
3.444	96.603	0.6790	-559.3064
3.491	99.311	0.7526	-559.3063
3.536	101.569	0.8200	-559.3062
3.579	103.337	0.8913	-559.3061
3.623	105.029	0.9588	-559.3060
3.664	106.594	1.0138	-559.3059
3.702	108.314	1.0636	-559.3058
3.736	109.766	1.1231	-559.3057
3.768	111.289	1.1962	-559.3056
3.796	112.796	1.2891	-559.3055
3.821	114.220	1.4095	-559.3053
3.843	115.698	1.5578	-559.3050
3.861	117.527	1.7251	-559.3048
3.877	119.268	1.9008	-559.3045
3.891	121.122	2.0823	-559.3042
3.902	122.747	2.2699	-559.3039
3.912	124.299	2.4566	-559.3036
3.919	125.738	2.6404	-559.3033
3.924	127.064	2.8175	-559.3030
3.927	128.531	2.9788	-559.3028
3.927	129.798	3.0931	-559.3026
3.927	130.549	3.1386	-559.3025
3.927	130.568	3.1404	-559.3025
3.927	130.009	3.0945	-559.3026
3.927	128.682	2.9905	-559.3028
3.925	127.178	2.8321	-559.3030
3.920	125.860	2.6556	-559.3033

3.912	124.424	2.4722	-559.3036
3.903	122.886	2.2858	-559.3039
3.892	121.249	2.0980	-559.3042
3.878	119.738	1.9173	-559.3045
3.862	117.694	1.7396	-559.3048
3.844	115.833	1.5715	-559.3050
3.823	114.332	1.4209	-559.3053
3.798	112.917	1.2981	-559.3055
3.770	111.423	1.2031	-559.3056
3.739	109.894	1.1287	-559.3057
3.705	108.435	1.0681	-559.3058
3.668	106.695	1.0182	-559.3059
3.627	105.144	0.9637	-559.3060
3.583	103.485	0.8975	-559.3061
3.540	101.728	0.8257	-559.3062
3.495	99.534	0.7584	-559.3063
3.449	97.217	0.6949	-559.3064
3.399	94.497	0.6258	-559.3065
3.348	92.052	0.5751	-559.3066
3.294	90.109	0.5232	-559.3067
3.238	88.169	0.4585	-559.3068
3.183	85.761	0.3550	-559.3070
3.128	84.133	0.2438	-559.3071
3.076	81.943	0.1304	-559.3073
3.033	79.944	0.0309	-559.3075
2.996	78.449	0.0000	-559.3075

Dihedral-angle scan of compound **2c,** Figure 3C.

d	ω	$E - E_{\circ}$	E (Hartrees)
3.367	119.144	2.6658	-919.6638
3.416	120.167	2.6837	-919.6638
3.464	121.443	2.7207	-919.6637
3.514	122.631	2.7793	-919.6636
3.563	122.688	2.8577	-919.6635
3.614	122.968	2.9720	-919.6633
3.668	123.288	3.1255	-919.6631
3.722	123.720	3.2759	-919.6628
3.773	124.085	3.3963	-919.6626
3.817	123.935	3.5167	-919.6625
3.856	123.960	3.6728	-919.6622
3.895	123.904	3.8644	-919.6619
3.934	123.717	4.0791	-919.6616
3.973	123.417	4.3151	-919.6612
4.010	123.215	4.5499	-919.6608

4.044	123.225	4.7918	-919.6604
4.073	122.787	5.0584	-919.6600
4.098	121.862	5.3430	-919.6595
4.120	120.826	5.6255	-919.6591
4.141	119.999	5.9191	-919.6586
4.160	119.327	6.2304	-919.6581
4.177	118.588	6.5598	-919.6576
4.191	117.857	6.9046	-919.6571
4.204	117.189	7.2599	-919.6565
4.215	116.471	7.6218	-919.6559
4.224	115.675	7.9922	-919.6553
4.230	114.681	8.3775	-919.6547
4.232	113.440	8.7738	-919.6541
4.234	112.213	9.1717	-919.6534
4.234	111.058	9.5640	-919.6528
4.161	132.608	3.2021	-919.6630
4.157	130.721	3.0164	-919.6633
4.150	129.233	2.8154	-919.6636
4.141	127.520	2.6045	-919.6639
4.129	125.831	2.3827	-919.6643
4.114	124.208	2.1631	-919.6646
4.097	122.255	1.9513	-919.6649
4.078	120.455	1.7497	-919.6653
4.054	118.727	1.5618	-919.6656
4.029	116.940	1.3892	-919.6658
4.000	115.088	1.2355	-919.6661
3.969	113.348	1.1088	-919.6663
3.935	111.661	1.0166	-919.6664
3.898	109.521	0.9494	-919.6665
3.858	107.337	0.8929	-919.6666
3.813	105.476	0.8364	-919.6667
3.761	103.965	0.7686	-919.6668
3.706	102.277	0.6655	-919.6670
3.654	100.052	0.5440	-919.6672
3.602	97.855	0.4396	-919.6674
3.548	95.084	0.3377	-919.6675
3.494	92.897	0.2563	-919.6676
3.435	91.176	0.1790	-919.6678
3.380	89.612	0.1015	-919.6679
3.328	88.246	0.0373	-919.6680
3.281	86.519	0.0000	-919.6681
3.239	84.905	0.0061	-919.6680
3.203	83.587	0.0743	-919.6679
3.176	81.953	0.2021	-919.6677
3.150	81.062	0.4205	-919.6674
3.124	80.198	0.7223	-919.6669
3.102	79.204	1.0987	-919.6663

3.082	78.262	1.5506	-919.6656
3.068	77.439	2.0764	-919.6647
3.058	76.516	2.6707	-919.6638
3.051	75.675	3.3253	-919.6628
3.045	74.972	4.0334	-919.6616
3.041	74.432	4.7913	-919.6604
3.039	73.967	5.5880	-919.6592
3.038	73.591	6.4095	-919.6578
3.038	73.322	7.2424	-919.6565
3.038	73.159	8.0757	-919.6552
3.039	73.054	8.9093	-919.6539
3.039	73.261	9.7347	-919.6525
3.031	74.332	10.5279	-919.6513
3.001	77.351	11.2606	-919.6501
2.915	93.465	11.7770	-919.6493
2.913	102.031	11.6938	-919.6494
2.921	105.196	11.3813	-919.6499
2.924	106.599	10.9473	-919.6506
2.928	107.685	10.4397	-919.6514
2.932	108.544	9.8818	-919.6523
2.936	109.181	9.2924	-919.6532
2.939	109.584	8.6932	-919.6542
2.943	109.901	8.1027	-919.6551
2.949	110.246	7.5295	-919.6561
2.956	110.672	6.9778	-919.6569
2.964	111.131	6.4520	-919.6578
2.974	111.571	5.9608	-919.6586
2.985	111.984	5.5134	-919.6593
2.998	112.404	5.1178	-919.6599
3.037	112.655	4.4781	-919.6609
3.099	110.913	3.9563	-919.6618
3.128	111.754	3.5884	-919.6623
3.161	112.696	3.2827	-919.6628
3.196	113.861	3.0397	-919.6632
3.235	115.177	2.8594	-919.6635
3.276	116.557	2.7402	-919.6637
3.320	117.940	2.6784	-919.6638
3.367	119.159	2.6657	-919.6638

Dihedral-angle scan of compound **2d,** Figure 3D.

d	ω	$E - E_{\circ}$	E (Hartrees)
3.495	118.020	2.5894	-3033.6474
3.543	118.900	2.5864	-3033.6474
3.585	119.643	2.6535	-3033.6473

3.628	120.591	2.7396	-3033.6471
3.682	121.864	2.8968	-3033.6469
3.739	122.076	2.9999	-3033.6467
3.786	121.607	3.1141	-3033.6465
3.837	122.273	3.3338	-3033.6462
3.889	121.652	3.4903	-3033.6459
3.930	121.659	3.6803	-3033.6456
3.971	121.515	3.8989	-3033.6453
4.014	121.574	4.1340	-3033.6449
4.055	121.759	4.3786	-3033.6445
4.093	122.090	4.6201	-3033.6441
4.126	121.790	4.8578	-3033.6438
4.154	120.708	5.0948	-3033.6434
4.181	120.284	5.3414	-3033.6430
4.205	119.733	5.6111	-3033.6426
4.227	119.294	5.9032	-3033.6421
4.246	118.891	6.2205	-3033.6416
4.263	118.291	6.5595	-3033.6411
4.276	117.219	6.9049	-3033.6405
4.289	116.452	7.2636	-3033.6399
4.300	115.806	7.6442	-3033.6393
4.310	115.033	8.0413	-3033.6387
4.318	114.075	8.4485	-3033.6380
4.324	113.034	8.8612	-3033.6374
4.330	112.096	9.2782	-3033.6367
4.253	135.793	3.6146	-3033.6457
4.253	133.656	3.4489	-3033.6460
4.249	131.729	3.2372	-3033.6463
4.243	129.890	3.0079	-3033.6467
4.233	128.165	2.7755	-3033.6471
4.221	126.218	2.5412	-3033.6475
4.207	124.351	2.3058	-3033.6478
4.189	122.479	2.0757	-3033.6482
4.168	120.808	1.8580	-3033.6485
4.145	119.173	1.6553	-3033.6489
4.118	117.535	1.4704	-3033.6492
4.088	115.881	1.3086	-3033.6494
4.056	114.029	1.1808	-3033.6496
4.020	112.183	1.0862	-3033.6498
3.976	110.460	1.0077	-3033.6499
3.931	108.516	0.9060	-3033.6501
3.883	106.212	0.7963	-3033.6502
3.834	104.489	0.7125	-3033.6504
3.784	102.444	0.6182	-3033.6505
3.732	99.741	0.5383	-3033.6507
3.667	97.901	0.4125	-3033.6509
3.609	95.801	0.2683	-3033.6511

3.554	94.164	0.1663	-3033.6512
3.505	92.338	0.0785	-3033.6514
3.458	90.249	0.0164	-3033.6515
3.413	88.233	0.0000	-3033.6515
3.366	86.600	0.0256	-3033.6515
3.317	85.526	0.0687	-3033.6514
3.280	84.670	0.1604	-3033.6513
3.250	83.893	0.3354	-3033.6510
3.225	83.207	0.5999	-3033.6506
3.203	82.395	0.9538	-3033.6500
3.185	81.509	1.3922	-3033.6493
3.168	80.583	1.9096	-3033.6485
3.154	79.641	2.4976	-3033.6475
3.142	78.716	3.1457	-3033.6465
3.133	77.728	3.8515	-3033.6454
3.127	76.814	4.6072	-3033.6442
3.124	75.989	5.4069	-3033.6429
3.123	75.250	6.2432	-3033.6416
3.124	74.572	7.0968	-3033.6402
3.126	74.065	7.9667	-3033.6388
3.127	73.724	8.8469	-3033.6374
3.128	73.615	9.7247	-3033.6360
3.125	74.079	10.5844	-3033.6346
3.114	75.413	11.3976	-3033.6333
3.093	78.086	12.1341	-3033.6322
3.027	92.161	12.5558	-3033.6315
3.023	100.144	12.5409	-3033.6315
3.029	102.921	12.2438	-3033.6320
3.035	104.731	11.8115	-3033.6327
3.038	105.901	11.2861	-3033.6335
3.040	106.721	10.7045	-3033.6344
3.041	107.255	10.0914	-3033.6354
3.043	107.655	9.4656	-3033.6364
3.046	108.020	8.8395	-3033.6374
3.050	108.318	8.2217	-3033.6384
3.055	108.648	7.6221	-3033.6394
3.062	108.964	7.0484	-3033.6403
3.070	109.312	6.5041	-3033.6411
3.080	109.717	5.9923	-3033.6420
3.093	110.128	5.5232	-3033.6427
3.108	110.574	5.1046	-3033.6434
3.129	110.043	4.7185	-3033.6440
3.184	108.545	4.2114	-3033.6448
3.211	109.364	3.7701	-3033.6455
3.239	110.173	3.4021	-3033.6461
3.269	111.137	3.1114	-3033.6465
3.302	112.206	2.8961	-3033.6469

3.340	113.412	2.7463	-3033.6471
3.387	114.844	2.6466	-3033.6473
3.435	116.428	2.5953	-3033.6474
3.495	118.062	2.5893	-3033.6474

Cartesian Coordinates and Total Energies

Compound **1a**

Sum of electronic and zero-point Energies: –1450.6636 Hartrees

Atom	*x*	*y*	*z*
C	2.32665300	-1.89867400	-0.56699900
C	1.17597500	-1.14131200	-0.35992900
C	1.24547100	0.21400200	-0.07136400
C	2.50701500	0.81047400	0.00087400
C	3.66115900	0.08226600	-0.19931500
C	3.54821500	-1.27468100	-0.48093200
H	2.25020600	-2.95403500	-0.79183400
H	2.57714200	1.86919300	0.22300700
C	0.00006900	1.01574200	0.20994500
O	0.00295500	-1.82512400	-0.46522700
C	-1.24369900	0.21137300	-0.07112800
C	-1.17147500	-1.14376800	-0.35964100
C	-2.32064300	-1.90355300	-0.56636900
C	-3.54348100	-1.28208000	-0.48027700
C	-3.65914100	0.07474000	-0.19891900
C	-2.50650100	0.80526100	0.00115400
O	-4.68419900	-2.02987200	-0.74085200
C	-0.00148500	2.36922100	-0.46609000
C	-0.00260700	3.35974200	0.49299000
C	-0.00184900	2.68298100	-1.81465900
C	-0.00422800	4.70806000	0.16456500
C	-0.00341900	4.02968600	-2.15828800
H	-0.00089900	1.91126000	-2.57509700
C	-0.00462100	5.03233400	-1.18318400
H	-0.00516600	5.46929800	0.93449800
H	-0.00372100	4.31081100	-3.20401600
H	-0.00585000	6.07055100	-1.48873200
C	-0.00175100	2.71359400	1.81933200
O	-0.00016500	1.37097200	1.63307100
O	-0.00218300	3.20590200	2.91326300
H	-2.57881700	1.86387100	0.22309500
H	-2.24204700	-2.95876200	-0.79113100
O	4.69097200	-2.01956800	-0.74116100
C	5.41767400	-2.43485900	0.33204300
C	-5.41813500	-2.43557700	0.33107900
C	6.62559700	-3.19782800	-0.10780300
H	6.31291300	-4.06702500	-0.68652800
H	7.23569500	-2.56772500	-0.75488500
H	7.19489400	-3.50909500	0.76227700
C	-6.62396000	-3.20103900	-0.11020500
H	-7.23376900	-2.57188600	-0.75858800
H	-6.30948800	-4.07016900	-0.68794700
H	-7.19458500	-3.51193800	0.75913700
O	5.09291800	-2.20156900	1.46188800
O	-5.10062800	-2.19297000	1.46103700
H	4.63798800	0.54312800	-0.14054000
H	-4.63684500	0.53373300	-0.14015100

Compound **1b**

Sum of electronic and zero-point Energies: –1648.8009 Hartrees

Atom	*x*	*y*	*z*
C	2.32582900	-2.02815700	-0.48252600
C	1.17390400	-1.26359000	-0.29093500
C	1.24419600	0.10239000	-0.05085900
C	2.50299000	0.71382500	-0.01661500
C	3.63393700	-0.03800100	-0.20972700
C	3.55522400	-1.41168800	-0.43971900
H	2.25101600	-3.09220300	-0.66596500
H	2.60135600	1.77920700	0.15934800
C	-0.00002700	0.91172000	0.22174900
O	-0.00003900	-1.95166100	-0.35785000
C	-1.24422500	0.10241100	-0.05094300
C	-1.17395200	-1.26354500	-0.29095300
C	-2.32591000	-2.02813500	-0.48252400
C	-3.55526100	-1.41164300	-0.43978300
C	-3.63396300	-0.03790700	-0.20988900
C	-2.50303600	0.71389600	-0.01677300
O	-4.69804500	-2.13972400	-0.68555700
C	0.00003100	2.25815100	-0.47110800
C	0.00005800	3.25915100	0.48128400
C	0.00005600	2.55784300	-1.82531800
C	0.00013100	4.60655700	0.13901400
C	0.00012100	3.90386400	-2.18162200
H	0.00002000	1.77811400	-2.57836500
C	0.00016200	4.91722800	-1.21458000
H	0.00016200	5.37600000	0.90167100
H	0.00013500	4.17515700	-3.23070300
H	0.00021500	5.95307500	-1.53066000
C	-0.00000500	2.62585700	1.81626100
O	-0.00008400	1.27863900	1.63979600
O	-0.00001700	3.12513000	2.90615500
H	-2.60132900	1.77928900	0.15915600
H	-2.25104200	-3.09218900	-0.66588700
O	4.69797400	-2.13979400	-0.68555900
C	5.58931200	-2.28432100	0.34655700
C	-5.58934200	-2.28421100	0.34658200
C	6.79277700	-3.04428000	-0.10749800
H	7.27473600	-2.50237700	-0.92238400
H	7.48076200	-3.16566800	0.72405300
H	6.48240400	-4.01758200	-0.48946900
C	-6.79271700	-3.04440000	-0.10730600
H	-7.27458500	-2.50292800	-0.92253400
H	-6.48225700	-4.01789300	-0.48873100
H	-7.48081500	-3.16539700	0.72420600
O	5.37480700	-1.84809900	1.43975500
O	-5.37486800	-1.84781400	1.43972000
F	4.84389100	0.53907500	-0.19556200
F	-4.84393100	0.53913600	-0.19577400

Compound **1c**

Sum of electronic and zero-point Energies: –2369.5262 Hartrees

Atom	*x*	*y*	*z*
C	2.32256500	-2.02597200	-0.54548700
C	1.17172900	-1.27077200	-0.33898400
C	1.24266000	0.08432100	-0.05283200
C	2.50020000	0.68507200	0.01548500
C	3.64506200	-0.05134800	-0.18733700
C	3.55073500	-1.41547700	-0.46688900
H	2.24910800	-3.08221900	-0.76691600
H	2.58236400	1.74342100	0.23277900
C	-0.00000700	0.89146900	0.23063100
O	-0.00016800	-1.95406000	-0.44058800
C	-1.24276700	0.08445700	-0.05280800
C	-1.17197900	-1.27062800	-0.33901500
C	-2.32290100	-2.02568500	-0.54561200
C	-3.55099000	-1.41505600	-0.46696700
C	-3.64518700	-0.05095400	-0.18723500
C	-2.50024800	0.68533500	0.01559900
O	-4.68443000	-2.15280700	-0.72922900
C	0.00006000	2.24383700	-0.44788700
C	0.00012900	3.23380900	0.51189500
C	0.00005900	2.55639200	-1.79656900
C	0.00019900	4.58199100	0.18335100
C	0.00012800	3.90327000	-2.13979100
H	0.00000700	1.78488400	-2.55714700
C	0.00019800	4.90563100	-1.16456800
H	0.00025600	5.34328600	0.95312500
H	0.00012900	4.18439700	-3.18545000
H	0.00025100	5.94378500	-1.47021300
C	0.00011000	2.58810200	1.83829000
O	0.00002400	1.24258200	1.65010000
O	0.00013600	3.07673200	2.93239700
H	-2.58228800	1.74367300	0.23299600
H	-2.24954600	-3.08191900	-0.76713900
O	4.68405200	-2.15342600	-0.72905400
C	5.45808400	-2.49783800	0.34582900
C	-5.45800900	-2.49799900	0.34567500
C	6.70216300	-3.19030000	-0.10227700
H	6.44061100	-4.05184500	-0.71609300
H	7.28554600	-2.50461000	-0.71794900
H	7.27745300	-3.49986900	0.76436100
C	-6.70198600	-3.19069500	-0.10237600
H	-7.28485000	-2.50584800	-0.71944800
H	-6.44007100	-4.05315100	-0.71479100
H	-7.27786000	-3.49911700	0.76428100
O	5.13335100	-2.25127500	1.47046300
O	-5.13297100	-2.25200400	1.47035900
Cl	-5.20604800	0.70151500	-0.10654300
Cl	5.20598200	0.70104000	-0.10691000

Compound **1d**

Sum of electronic and zero-point Energies: –1493.7907 Hartrees

Atom	*x*	*y*	*z*
C	2.33364300	-1.36552300	0.32714500
C	1.17123200	-0.58743600	0.38040900
C	1.24818000	0.79832900	0.34228500
C	2.49846700	1.40869000	0.23573100
C	3.64715000	0.64566300	0.18259500
C	3.57069400	-0.74775300	0.23997600
H	2.56848900	2.48938400	0.19374400
C	-0.00001300	1.64198400	0.46746500
O	0.00012500	-1.26591400	0.46356600
C	-1.24813200	0.79821000	0.34226800

C	-1.17105200	-0.58754600	0.38042500
C	-2.33338000	-1.36575900	0.32719100
C	-3.57049600	-0.74811700	0.24002400
C	-3.64708700	0.64528500	0.18256400
C	-2.49847900	1.40843500	0.23566900
O	-4.71428800	-1.50097600	0.25155100
C	-0.00008500	2.83975200	-0.45825100
C	-0.00019700	3.99518700	0.29975400
C	-0.00004100	2.88918600	-1.84359900
C	-0.00026800	5.25858200	-0.27964000
C	-0.00010300	4.14915300	-2.43630500
H	0.00003800	1.98649500	-2.44354000
C	-0.00021300	5.32003600	-1.66705600
H	-0.00034400	6.15249200	0.33222600
H	-0.00005900	4.22746700	-3.51681300
H	-0.00025700	6.28198000	-2.16429800
C	-0.00021200	3.61189900	1.72634000
O	-0.00005400	2.25143400	1.79315600
O	-0.00026200	4.29444900	2.71056100
H	-2.56864500	2.48911900	0.19365900
O	4.71460600	-1.50043900	0.25142400
C	5.21795600	-1.89497100	-0.96752300
C	-5.21828600	-1.89459900	-0.96740600
C	6.48828900	-2.65447000	-0.78038600
H	7.23263800	-1.98752800	-0.34110900
H	6.32289700	-3.47852800	-0.08575900
H	6.83599800	-3.02495900	-1.74033400
C	-6.48881100	-2.65377000	-0.78021800
H	-6.32379000	-3.47762500	-0.08526600
H	-7.23304100	-1.98645200	-0.34130300
H	-6.83647900	-3.02446300	-1.74010100
O	4.66693000	-1.62444300	-1.99311900
O	-4.66761100	-1.62362200	-1.99307600
Br	5.33918300	1.46483700	0.00573200
Br	-5.33920800	1.46430000	0.00574000
Br	2.22085400	-3.24094500	0.35840700
Br	-2.22041600	-3.24116300	0.35839700

Compound **1e**

Sum of electronic and zero-point Energies: –1493.7907 Hartrees

Atom	*x*	*y*	*z*
C	2.33083100	-1.20026100	-0.12202800
C	1.17312800	-0.43845700	0.03640100
C	1.24282900	0.94531400	0.10941900
C	2.48369800	1.56788200	0.00710800
C	3.63213300	0.82443600	-0.15637400
C	3.55556600	-0.56438900	-0.22257400
H	2.54117300	2.64750200	0.06260300
C	0.00000200	1.75651900	0.38119200
O	-0.00001100	-1.11934000	0.11445400
C	-1.24283200	0.94532500	0.10942200
C	-1.17314400	-0.43844600	0.03639700
C	-2.33085300	-1.20023800	-0.12204500
C	-3.55558300	-0.56435500	-0.22258500
C	-3.63213900	0.82446900	-0.15636500
C	-2.48369600	1.56790400	0.00711900
O	-4.69131600	-1.30355800	-0.44590700
C	0.00000700	3.10425800	-0.30233700
C	0.00001700	4.09643600	0.65510300
C	-0.00000100	3.41300600	-1.65159700
C	0.00001900	5.44335100	0.32306200
C	0.00000200	4.75911700	-1.99826300
H	-0.00001000	2.63988900	-2.41037000
C	0.00001200	5.76360600	-1.02575100
H	0.00002800	6.20647300	1.09090400
H	-0.00000400	5.03724900	-3.04466000
H	0.00001400	6.80096800	-1.33396400
C	0.00002600	3.45603000	1.98381300
O	0.00000700	2.10894600	1.80031300
O	0.00001800	3.94801900	3.07570300
H	-2.54116000	2.64752400	0.06262300
O	4.69129300	-1.30360500	-0.44588300
C	5.39575200	-1.70311800	0.66213400
C	-5.39570900	-1.70319700	0.66210800
C	6.61808900	-2.45514400	0.25832800
H	6.32780800	-3.31839600	-0.34119000
H	7.24255200	-1.81017000	-0.36125100
H	7.16015800	-2.77083700	1.14394800
C	-6.61801700	-2.45526300	0.25828900
H	-7.24252100	-1.81030100	-0.36126000
H	-6.32769600	-3.31847900	-0.34126300
H	-7.16005700	-2.77102000	1.14390300
O	5.02919800	-1.44786500	1.77080100
O	-5.02912000	-1.44802100	1.77078100
I	-5.49876100	1.78455800	-0.30859900
I	-2.22460100	-3.29513800	-0.19604600
I	2.22456700	-3.29516200	-0.19598900
I	5.49876400	1.78450200	-0.30864900

Compound **1f**

Sum of electronic and zero-point Energies: –6597.4709 Hartrees

Atom	*x*	*y*	*z*
C	2.31800300	-2.16594800	-0.36214300
C	1.17223800	-1.40284000	-0.15036200
C	1.24307000	-0.02657900	0.03094800
C	2.49658100	0.58938000	-0.02243600
C	3.63945700	-0.15475600	-0.23962300
C	3.54456300	-1.54010000	-0.40462500
H	2.24324700	-3.23671800	-0.50220000
H	2.57322000	1.66330800	0.10403900
C	-0.00001100	0.77509900	0.33792800
O	-0.00011100	-2.09411600	-0.14075700
C	-1.24315400	-0.02650000	0.03096400
C	-1.17240800	-1.40274900	-0.15041500
C	-2.31821600	-2.16577100	-0.36232400
C	-3.54472800	-1.53983900	-0.40477400
C	-3.63955100	-0.15451500	-0.23957300
C	-2.49663600	0.58954000	-0.02234200
O	-4.66556900	-2.29221000	-0.68010700
C	0.00003700	2.14918400	-0.29460400
C	0.00009200	3.10784200	0.70026100
C	0.00003800	2.50518900	-1.63459100
C	0.00014600	4.46866000	0.41479200
C	0.00009100	3.86512300	-1.93394200
H	-0.00000400	1.75777700	-2.41964900
C	0.00014500	4.83614000	-0.92451700
H	0.00019000	5.20513500	1.20927400
H	0.00009200	4.18111200	-2.97034300
H	0.00018800	5.88468800	-1.19565500
C	0.00008100	2.41628500	2.00673500
O	0.00001400	1.07766000	1.77108900
O	0.00010900	2.86688600	3.11743400
H	-2.57320800	1.66345800	0.10424100
H	-2.24351100	-3.23652800	-0.50250200
O	4.66532500	-2.29263400	-0.67980500
C	5.49186400	-2.59581200	0.37115900
C	-5.49175400	-2.59611100	0.37094100
C	6.71253000	-3.30721600	-0.11300400
H	6.42376700	-4.17140600	-0.71155700
H	7.28226100	-2.63010100	-0.75235800
H	7.31502900	-3.61436900	0.73705500
C	-6.71241500	-3.30747700	-0.11328900
H	-7.28146200	-2.63098600	-0.75388200
H	-6.42345000	-4.17247100	-0.71061800
H	-7.31555100	-3.61359300	0.73669000
O	5.22163300	-2.30059900	1.49905300
O	-5.22116400	-2.30161000	1.49893100
Br	5.32762100	0.68766400	-0.35452700
Br	-5.32770900	0.68794500	-0.35422200

Compound **2a**

Sum of electronic and zero-point Energies: –459.9220 Hartrees

Atom	*x*	*y*	*z*
C	-2.84935000	0.00037400	0.26869200
C	-2.17942500	-1.20571600	0.07975400
C	-0.83915200	-1.21230100	-0.29451300
C	-0.18659900	-0.00047400	-0.46940300
C	-0.83877000	1.21175600	-0.29591500
C	-2.17904000	1.20602900	0.07838200
H	-3.89294400	0.00071000	0.55902500
H	-2.69878900	-2.14574400	0.22102000
H	-0.30033900	-2.13928700	-0.45146400
H	-2.69810000	2.14638700	0.21857800
O	1.14049100	-0.00094200	-0.89411700
C	2.16214000	-0.00005200	0.00511200
O	3.28145700	-0.00038500	-0.42687200
C	1.80537300	0.00126900	1.46382300
H	1.20942700	0.88222600	1.70790400
H	1.20886400	-0.87888600	1.70939600
H	2.72490800	0.00150000	2.04177700
H	-0.29967700	2.13840000	-0.45393000

Compound **2b**

Sum of electronic and zero-point Energies: –559.1725 Hartrees

Atom	*x*	*y*	*z*
C	2.92649600	-0.05439500	0.23022700
C	2.38964000	-1.33288900	0.11789800
C	1.03499100	-1.50148700	-0.15707400
C	0.22784100	-0.38894300	-0.32328700
C	0.77641000	0.88143200	-0.21010600
C	2.11641300	1.06661200	0.06606900

H	3.97946200	0.07767800	0.44463500
H	3.02224700	-2.20206700	0.24463000
H	0.59190500	-2.48553800	-0.25037200
H	2.50660500	2.07346300	0.14625100
F	-0.02903600	1.94241200	-0.38365500
O	-1.10636300	-0.53956100	-0.65754400
C	-2.03521600	-0.18119100	0.27746500
O	-1.73125000	0.21021200	1.36809300
C	-3.41840800	-0.34846300	-0.26565100
H	-3.57027000	0.37280400	-1.07064200
H	-3.53337900	-1.34803500	-0.68467200
H	-4.14335100	-0.17927700	0.52543500

Compound **2c**

Sum of electronic and zero-point Energies: –919.5348 Hartrees

Atom	*x*	*y*	*z*
C	2.96978400	-0.29655200	0.23919800
C	2.42213400	-1.54856000	-0.02158500
C	1.06869000	-1.66904600	-0.31762000
C	0.27122200	-0.53608600	-0.35637200
C	0.81942000	0.71629100	-0.09592600
C	2.16926000	0.84070200	0.20284900
H	4.02304000	-0.19804900	0.46990600
H	3.04559900	-2.43338700	0.00436900
H	0.61564100	-2.63093500	-0.52480800
H	2.58327500	1.82129000	0.40091100
O	-1.05991300	-0.65387300	-0.71456100
C	-1.98971100	-0.56898100	0.28204500
O	-1.68623300	-0.47896300	1.43754700
C	-3.37205600	-0.58758800	-0.28629300
H	-3.53934300	0.35382300	-0.81421700
H	-3.47181600	-1.39922500	-1.00625000
H	-4.09596600	-0.69313200	0.51679500
Cl	-0.19668900	2.12595500	-0.15931600

Compound **2d**

Sum of electronic and zero-point Energies: –3033.5073 Hartrees

Atom	*x*	*y*	*z*
C	-3.06256100	0.51019200	0.23964100
C	-2.58549100	1.78093000	-0.06567600
C	-1.24101200	1.96519600	-0.36725800
C	-0.37982400	0.87814600	-0.36617800
C	-0.85678400	-0.39250200	-0.06024300
C	-2.19945200	-0.58059100	0.24359400
H	-4.10890900	0.36008500	0.47428200
H	-3.25695400	2.63017600	-0.07004200
H	-0.84265700	2.94294200	-0.61005300
H	-2.56206400	-1.57299000	0.47845500
O	0.94268300	1.06627700	-0.72726700
C	1.86140500	1.15920400	0.27878000
O	1.55109600	1.13995000	1.43600300
C	3.24199200	1.27869400	-0.28166200
H	3.47730200	0.37052500	-0.83945200
H	3.28490900	2.11891500	-0.97517900
H	3.95385000	1.41648000	0.52712500
Br	0.32670400	-1.87175900	-0.06802900