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Supporting Information

A Highly Efficient Ruthenium-Catalyzed Rearrangement of α,β -Epoxyketones to 1,2-Diketones.

Chia-Lung Chang, Manyam Praveen Kumar and Rai-Shung Liu*

Department of Chemistry, National Tsing-Hua University, Hsinchu, Taiwan (ROC)
.....rsliu@mx.nthu.edu.tw

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(1) Procedure for Catalytic Reactions

To a toluene solution (0.70 mL) was added epoxide **1** (100 mg, 0.56 mmol) and $\text{TpRuPPh}_3(\text{CH}_3\text{CN})_2\text{PF}_6$ (43 mg, 0.056 mmol), and the reaction mixture was heated at 100 °C for 5 h. The solution was filtered over a short silica bed and then washed with diethyl ether (4 mL). Concentration of the filtrate under reduced pressure gave 1,2-diketone **2** as a yellow oil (99 mg, 0.55 mmol, 99%).

(2) Spectral data for α,β -Epoxyketones and 1,2-diketones**(4-Methoxy-phenyl)-oxiranyl-methanone **1****

$R_f=0.41$ (ether:hexane = 1:3); IR (neat, cm^{-1}): 3032(w), 1722(s), 1622(w); ^1H NMR (400 MHz, CDCl_3): δ 8.03(d, $J = 8.4$ Hz, 2H), 6.95(d, $J = 8.4$ Hz, 2H), 4.18(t, $J = 2.6$ Hz, 1H), 3.87(s, 3H), 3.06(t, $J = 2.6$ Hz, 1H), 2.96–2.93(m, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ 192.8, 164.0, 130.5, 128.3, 113.9, 55.3, 50.6, 47.2; HMRS calcd for $\text{C}_{10}\text{H}_{10}\text{O}_3$: 178.0630, Found: 178.0634.

1-(4-Methoxy-phenyl)-propane-1,2-dione **2**

$R_f=0.59$ (ether : hexane = 1:3); IR (neat, cm^{-1}): 3031(w), 1732(s), 1720(s), 1622(w); ^1H NMR (400MHz, CDCl_3): δ 7.94(d, $J = 8.4$ Hz, 2H), 6.94(d, $J = 8.4$ Hz, 2H), 3.87(s, 3H), 2.48(s, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 201.1, 189.9, 164.7, 132.7, 124.6, 114.1, 55.5, 26.4; HMRS calcd for $\text{C}_{10}\text{H}_{10}\text{O}_3$: 178.0630, Found: 178.0631.

Oxiranyl-phenyl-methanone: 3a

$R_f=0.52$ (ether: hexane =1:3); IR (neat, cm^{-1}): 3033(w), 1717(s), 1619(w); ^1H NMR (400 MHz, CDCl_3): δ 8.03 (d, $J = 7.2$ Hz, 2 H), 7.58 (t, $J = 7.2$ Hz, 1 H), 7.48 (t, $J = 7.2$ Hz, 2 H), 4.22 (dd, $J = 4.4, 2.4$ Hz, 1 H), 3.10 (dd, $J = 6.4, 4.4$ Hz, 1 H), 2.95 (dd, $J = 6.4, 4.4$ Hz, 1 H); ^{13}C NMR (125 MHz, CDCl_3): δ 194.5, 135.3, 133.8, 128.7, 128.2, 50.9, 47.4; HMRS calcd for $\text{C}_9\text{H}_8\text{O}_2$: 148.0524, Found : 148.0526.

1-Phenyl-propane-1,2-dione: 4a

$R_f=0.57$ (ether:hexane=1:3); IR (neat, cm^{-1}): 3035(w), 1716(s), 1617(w); ^1H NMR (400 MHz, CDCl_3): δ 7.99 (d, $J = 7.6$ Hz, 2 H), 7.62 (t, $J = 7.6$ Hz, 1 H), 7.48 (t, $J = 7.6$ Hz, 2 H), 2.51 (s, 3 H); ^{13}C NMR (125 MHz CDCl_3): δ 200.5, 191.3, 134.5, 131.7, 130.2, 128.8, 26.3; HMRS calcd for $\text{C}_{10}\text{H}_{10}\text{O}_2$: 148.0524, Found : 148.0526.

(4-Fluoro-phenyl)-oxiranyl-methanone 3b

$R_f=0.57$ (ether:hexane = 1:3); IR (neat, cm^{-1}): 3045 (w), 1721(s), 1625(w); ^1H NMR (400 MHz, CDCl_3): δ 8.07(dd, $J = 8.4, 5.2$ Hz, 2H), 7.15(t, $J = 8.8$ Hz, 2H), 4.16(dd, $J = 4.0, 2.4$

Hz, 1H), 3.11(dd, $J = 6.4, 4.4$ Hz, 1H), 2.95(dd, $J = 6.8, 2.0$ Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ 193.1, 166.1(d, $J_{\text{CF}} = 255$ Hz), 131.7, 131.1, 131.0, 116.0, 115.9, 51.1, 47.4; HMRS calcd for $\text{C}_9\text{H}_7\text{FO}_2$: 166.0430, Found : 166.0434.

1-(4-Fluoro-phenyl)-propane-1,2-dione 4b

$R_f=0.69$ (ether:hexane = 1:3); IR (neat, cm^{-1}): 3037(w), 1736(s), 1718(s), 1624(w); ^1H NMR (400MHz, CDCl_3): δ 8.05(dd, $J = 8.8, 5.2$ Hz, 2H), 7.49(t, $J = 8.8$ Hz, 2H), 2.49(s, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 200.1, 189.2, 166.6(d, $J_{\text{CF}} = 255$ Hz), 133.3, 133.2, 128.3, 116.2, 116.0, 26.2; HMRS calcd for $\text{C}_9\text{H}_7\text{FO}_2$: 166.0430, Found : 166.0433.

4-Oxiranecarbonyl-benzonitrile 3c

$R_f=0.35$ (ether:hexane = 1:3); IR (neat, cm^{-1}): 3031(w), 2225(w), 1726 (s), 1624(w); ^1H NMR (400MHz, CDCl_3): δ 8.11(d, $J = 8.0$ Hz, 2H), 7.78(d, $J = 8.0$ Hz, 2H), 4.15(dd, $J = 4.4, 2.8$ Hz, 1H), 3.15(dd, $J = 6.4, 4.4$ Hz, 1H), 2.95(dd, $J = 6.4, 2.0$ Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ 193.8, 137.8, 132.4, 128.5, 117.5, 116.6, 51.2, 47.4; HMRS calcd for $\text{C}_{10}\text{H}_7\text{NO}_2$: 173.0477, Found : 173.0481.

4-(2-Oxo-propionyl)-benzonitrile 4c

$R_f=0.44$ (ether:hexane = 1:3); IR (neat, cm^{-1}): 3032(w), 2228 (w), 1732(s), 1712(s), 1621(w); ^1H NMR (400MHz, CDCl_3): δ 8.11(d, $J = 8.0$ Hz, 2H), 7.75(d, $J = 8.0$ Hz, 2H),

2.52(s, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 198.7, 188.6, 135.0, 132.4, 130.7, 117.6, 117.4, 25.9; HMRS calcd for $\text{C}_{10}\text{H}_7\text{NO}_2$: 173.0477, Found : 173.0479.

(4-*tert*-Butyl-phenyl)-oxiranyl-methanone 3d

R_f =0.56 (ether:hexane = 1:3); IR (neat, cm^{-1}): 3035(w), 1726(s), 1620(w); ^1H NMR (400MHz, CDCl_3): δ 7.93(d, J = 8.8 Hz, 2H), 7.45(d, J = 8.8 Hz, 2H), 4.18(dd, J = 4.8, 2.0 Hz, 1H), 3.03(dd, J = 6.4, 4.4 Hz, 1H), 2.87(dd, J = 6.4, 2.8 Hz, 1H), 1.25(s, 9H); ^{13}C NMR (100 MHz, CDCl_3): δ 194.1, 157.9, 132.9, 128.3, 125.8, 51.0, 47.4, 35.2, 31.0; HMRS calcd for $\text{C}_{13}\text{H}_{16}\text{O}_2$: 204.1150, Found : 204.1156.

1-(4-*tert*-Butyl-phenyl)-propane-1,2-dione 4d

R_f =0.72 (ether:hexane = 1:3); IR (neat, cm^{-1}): 3031(w), 1735(s), 1714(s), 1614(w); ^1H NMR (400MHz, CDCl_3): δ 7.92(d, J = 8.0 Hz, 2H), 7.49(d, J = 8.0 Hz, 2H), 2.49(s, 3H), 1.32(s, 9H); ^{13}C NMR (100 MHz, CDCl_3): δ 200.8, 191.1, 158.6, 130.2, 129.6, 125.8, 35.2, 31.0, 26.3; HMRS calcd for $\text{C}_{13}\text{H}_{16}\text{O}_2$: 204.1150, Found : 204.1152.

Naphthalen-2-yl-oxiranyl-methanone: 3e

$R_f = 0.53$ (ether:hexane =1:3); IR (neat, cm^{-1}): 3033(w), 1717(s), 1619(w) 1609(m); ^1H NMR (400 MHz, CDCl_3): δ 6.0 (s, 1 H), 8.03 (d, $J = 8.4$ Hz, 1 H), 7.96 (d, $J = 8$ Hz, 1 H), 7.90 (d, $J = 8.4$ Hz, 1 H), 7.87 (d, $J = 8$ Hz, 1 H), 7.62 (t, $J = 7.2$ Hz, 1 H), 7.56 (t, $J = 7.2$ Hz, 1 H), 4.36 (dd, $J = 4.4, 2.4$ Hz, 1 H), 3.17 (dd, $J = 6.4, 4.4$ Hz, 1 H), 3.02 (dd, $J = 6.4, 4.4$ Hz, 1 H); ^{13}C NMR (125 MHz CDCl_3): δ 194.4, 135.9, 132.3, 130.4, 129.6, 128.7, 127.8, 127.0, 123.6; 51.2, 47.6; HMRS calcd for $\text{C}_{13}\text{H}_{10}\text{O}_2$: 198.0681, Found : 198.0683.

1-Naphthalen-2-yl-propane-1,2-dione: 4e

$R_f = 0.58$ (ether:hexane =1:3); IR (neat, cm^{-1}): 3035(w), 1719(s), 1618(w) 1608(m); ^1H NMR (400 MHz, CDCl_3): δ 8.54 (s, 1 H), 8.01 (d, $J = 8.4$ Hz, 1 H), 7.93 (d, $J = 8$ Hz, 1 H), 7.89 (d, $J = 8.4$ Hz, 1 H), 7.84 (d, $J = 8$ Hz, 1 H), 7.61 (t, $J = 7.2$ Hz, 1 H), 7.53 (t, $J = 7.2$ Hz, 1 H), 2.56 (s, 3 H); ^{13}C NMR (125 MHz, CDCl_3): δ 200.6, 191.3, 136.1, 133.6, 132.2, 129.9, 129.3, 128.8, 127.8, 126.9, 14.2, 26.4; HMRS calcd for $\text{C}_{13}\text{H}_{10}\text{O}_2$: 198.0681, Found : 198.0684.

Cyclohexyl-oxiranyl-methanone: 3f

R_f=0.52 (ether:hexane =1:3); IR (neat, cm⁻¹): 3019(w), 1718(s), 1621(w) 1609(m); ¹H NMR (400 MHz, CDCl₃): δ 3.45 (dd, *J* = 4.4, 2.4 Hz, 1 H), 2.93 (dd, *J* = 6.4, 4.4 Hz, 1 H), 2.77 (dd, *J* = 6.0, 2.4 Hz, 1 H), 2.46~2.39 (m, 1 H), 1.88~1.62 (m, 5 H), 1.46~1.36 (m, 1 H), 1.32~1.18 (m, 4 H); ¹³C NMR (125 MHz, CDCl₃): δ 209.6, 52.0, 46.2, 45.5, 28.4, 27.4, 25.5, 25.5, 25.1 ; HMRS calcd for C₉H₁₄O₂ : 154.0994, Found : 154.0996.

1-Cyclohexyl-propane-1,2-dione: 4f

R_f = 0.56 (ether:hexane =1:3); IR (neat, cm⁻¹): 3013(w), 2948(m), 1718(s), 1617(w) ; ¹H NMR (400 MHz, CDCl₃): δ 3.13~3.07 (m, 1 H), 2.27 (s, 3 H), 1.68~1.63 (m, 5 H), 1.35~1.15 (m, 5 H); ¹³C NMR (125 MHz, CDCl₃): δ 202.0, 198.2, 42.7, 27.6, 25.7, 25.3, 24.3 ; HMRS calcd for C₉H₁₄O₂ : 154.0994, Found : 154.0998.

1- Oxiranyl-nonan-1-one: 3g

R_f=0.54 (ether:hexane=1:3); IR (neat, cm⁻¹): 3034(w), 1718(s), 1618(w); ¹H NMR (400MHz, CDCl₃): δ 3.36 (dd, *J* = 4.2, 2.0 Hz, 1 H), 2.92 (dd, *J* = 6.4, 4.4 Hz, 1 H), 2.80 (dd, *J* = 6.4, 2.8 Hz, 1 H), 2.40~2.32 (m, 1 H), 2.26~2.18 (m, 1 H), 1.53~1.48 (m, 2 H), 1.30~1.17 (m, 10 H), 0.811 (t, *J* = 7.6 Hz, 3 H); ¹³C NMR (100 MHz, CDCl₃): δ 207.6, 76.6, 53.2, 45.9, 36.4, 29.1, 29.0, 28.9, 22.9, 22.5, 13.9; HMRS calcd for C₁₁H₂₀O₂: 184.1463, Found : 184.1466.

Undecane-2,3-dione: 4g

R_f = 0.56 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3031(w), 1733(s), 1712(s), 1627(w); ¹H NMR (400 MHz, CDCl₃): δ 2.70 (t, *J* = 7.2 Hz, 2 H), 2.30 (s, 3 H), 1.59~1.50 (m, 2 H), 1.32~1.18 (m, 10 H), 0.852 (t, *J* = 7.6 Hz, 3 H); ¹³C NMR (150 MHz, CDCl₃): δ 199.6, 197.5, 35.6, 31.7, 29.2, 29.0, 23.6, 23.0, 22.5, 14.0; HRMS calcd For C₁₁H₂₀O₂: 184.1463, Found: 184.1464.

3-(E)-Butyl-oxiranyl-phenyl-methanone 5a

R_f=0.51 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3034(w), 1720(s), 1622(w); ¹H NMR (400MHz, CDCl₃): δ 7.99(d, *J* = 7.3 Hz, 2H), 7.60(t, *J* = 7.3 Hz, 1H), 7.48(t, *J* = 7.3 Hz, 2H), 4.00(d, *J* = 2.0 Hz, 1H), 3.14~3.10(m, 1H), 1.77~1.66(m, 2H), 1.52~1.46(m, 2H), 1.44~1.36(m, 2H), 0.91(t, *J* = 6.8 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 194.5, 135.4, 133.6, 128.6, 128.1, 59.9, 57.2, 31.5, 27.2, 22.2, 13.7; HMRS calcd for C₁₃H₁₆O₂: 204.1150, Found : 204.1154.

1-Phenyl-heptane-1,2-dione 6a

R_f=0.75 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3037(w), 1735(s), 1712(s), 1618 (w); ¹H NMR (400MHz, CDCl₃): δ 7.97(d, *J* = 7.8 Hz, 2H), 7.64 (t, *J* = 7.8 Hz, 1H), 7.50(t, *J* = 7.8

Hz, 2H), 2.87(t, $J = 7.4$ Hz, 2H), 1.72~1.70(m, 2H), 1.38~1.32(m, 4H), 0.90 (t, $J = 7.4$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 203.4, 192.5, 134.4, 131.9, 130.0, 128.7, 38.6, 31.2, 22.4, 22.3, 13.8; HMRS calcd for $\text{C}_{13}\text{H}_{16}\text{O}_2$: 204.1150, Found : 204.1152.

3-(Z)-Hexyl-oxiranyl-phenyl-methone 5b

R_f =0.51 (ether:hexane = 1:3); IR (neat, cm^{-1}): 3034(w), 1718(s), 1621(w); ^1H NMR (400 MHz, CDCl_3): δ 8.00 (d, $J = 7.6$ Hz, 2H), 7.60(t, $J = 7.6$ Hz, 1H), 7.49(t, $J = 7.6$ Hz, 2H), 4.26(d, $J = 4.8$ Hz, 1H), 3.41~3.39(m, 1H), 1.47~1.42(m, 2H), 1.24~1.16(m, 8H), 0.79(t, $J = 6.8$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 193.9, 135.7, 133.8, 128.7, 128.1, 58.8, 57.5, 31.4, 28.8, 27.4, 26.0, 22.3, 13.9; HMRS calcd for $\text{C}_{15}\text{H}_{20}\text{O}_2$: 232.1463, Found : 232.1466.

1-Phenyl-nonane-1,2-dione 6b

R_f =0.78 (ether:hexane = 1:3); IR (neat, cm^{-1}): 3034(w), 1735(s), 1714(s), 1618(w); ^1H NMR (400MHz, CDCl_3): δ 7.95(d, $J = 8.0$ Hz, 2H), 7.62(t, $J = 8.0$ Hz, 1H), 7.48(t, $J = 8.0$ Hz, 2H), 2.85(t, $J = 7.2$ Hz, 2H), 1.70~1.66(m, 2H), 1.35~1.23(m, 8H), 0.86(t, $J = 7.2$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 203.4, 192.5, 134.4, 132.0, 130.1, 128.7, 38.7, 31.5, 29.0, 28.9, 22.8, 22.5, 14.0; HMRS calcd for $\text{C}_{15}\text{H}_{20}\text{O}_2$: 232.1463, Found : 232.1464.

(3-Methyl-oxiranyl)-phenyl-methanone 5c

R_f=0.54 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3032(w), 1719(s), 1620(w); ¹H NMR (400MHz, CDCl₃): cis : trans = 3.5 : 1, for cis isomer δ 7.99 (d, *J* = 7.2 Hz, 2H), 7.60(t, *J* = 7.4 Hz, 1H), 7.50~7.47(m, 2H), 4.24(d, *J* = 4.8 Hz, 1H), 3.55~3.50(m, 1H), 1.24(d, *J* = 6.0 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃): cis isomer δ 193.7, 135.6, 133.7, 128.7, 128.0, 57.4, 54.3, 12.9; HMRS calcd for C₁₀H₁₀O₂: 162.0681, Found : 162.0683

1-Phenyl-butane-1,2-dione 6c

R_f=0.77 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3034(w), 1732(s), 1713(s), 1618(w); ¹H NMR (400MHz, CDCl₃): δ 7.96 (d, *J* = 8.0 Hz, 2H), 7.62(t, *J* = 8.0 Hz, 1H), 7.48(t, *J* = 8.0 Hz, 2H), 2.90(q, *J* = 7.2 Hz, 2H), 1.18(t, *J* = 7.2 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 203.7, 192.4, 134.4, 131.9, 130.0, 128.7, 32.0, 6.7; HMRS calcd for C₁₀H₁₀O₂: 162.0681, Found : 162.0683.

(3-Methyl-oxiranyl)-naphthalen-2-yl-methanone: 5d

R_f = 0.53 (ether:hexane =1:3); IR (neat, cm⁻¹): 3035(w), 1718(s), 1616(w) 1627(m); ¹H NMR (400 MHz, CDCl₃): δ 8.55 (s, 1 H), 8.03 (d, *J* = 8.4 Hz, 1 H), 7.96 (d, *J* = 8 Hz, 1 H), 7.90 (d, *J* = 8.4 Hz, 1 H), 7.87 (d, *J* = 8 Hz, 1 H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.55 (t, *J* = 7.2 Hz, 1 H), 4.37 (d, *J* = 4.8 Hz, 1 H), 3.59 (p, *J* = 4.8 Hz, 1 H), 1.27 (d, *J* = 5.2 Hz, 3 H); ¹³C NMR (125 MHz, CDCl₃): δ 193.7, 135.8, 133.1, 132.3, 130.3, 129.6, 128.9, 128.7, 127.8, 127.0, 123.4, 57.7, 54.4, 13.2; HRMS calcd for C₁₄H₁₂O₂: 212.0837, Found: 212.0839.

1-Naphthalen-2-yl-butane-1,2-dione: 6d

R_f = 0.55 (ether:hexane =1:3); IR (neat, cm⁻¹): 3033(w), 1719(s), 1618(w) 1625(m); ¹H NMR (400 MHz, CDCl₃): δ 8.50 (s, 1 H), 8.01 (d, *J* = 8.4 Hz, 1 H), 7.94 (d, *J* = 8 Hz, 1 H), 7.91 (d, *J* = 8.4 Hz, 1 H), 7.86 (d, *J* = 8.4 Hz, 1 H), 7.62 (t, *J* = 7.6 Hz, 1 H), 7.55 (t, *J* = 7.6 Hz, 1 H), 2.96 (qt, *J* = 7.6 Hz, 2 H), 1.23 (t, *J* = 6.4 Hz, 3 H); ¹³C NMR (125 MHz, CDCl₃): δ 203.9, 192.5, 136.2, 133.5, 132.3, 129.9, 129.3, 128.9, 127.8, 127.0, 124.1, 32.2, 6.4; HRMS calcd for C₁₄H₁₂O₂: 212.0837, Found: 212.0838.

Cyclohexyl-(3-methyl-oxiranyl)-methanone: 5e

R_f = 0.52 (ether:hexane =1:3); IR (neat, cm⁻¹): 3016(w), 2944(m), 1716(s), 1623(w) ; ¹H NMR (400 MHz, CDCl₃): δ 3.61 (d, *J* = 4.8 Hz, 1 H), 3.29–3.24 (m, 1 H), 2.52 (tt, *J* = 10.8, 3.2 Hz, 1 H), 1.87 (d, *J* = 11.2 Hz, 1 H), 1.74 (d, *J* = 12 Hz, 4 H), 1.16 (d, *J* = 12 Hz, 1 H), 1.43–1.32 (m, 1 H) 1.29–1.2 (m, 3 H), 1.17 (d, *J* = 5.6 Hz, 3 H); ¹³C NMR (125 MHz, CDCl₃): δ 208.0, 57.6, 54.2, 48.7, 27.9, 26.9, 25.6, 25.1, 12.9; HRMS calcd for C₁₀H₁₆O₂: 168.1150, Found: 168.1153.

1-Cyclohexyl-butane-1,2-dione: 6e

$R_f = 0.54$ (ether:hexane =1:3); IR (neat, cm^{-1}): 3018(w), 2948(m), 1717(s), 1627(w); ^1H NMR (400 MHz, CDCl_3): δ 3.11 (dt, $J = 10.4, 2.0$ Hz, 1 H), 2.71 (qt, $J = 7.2$ Hz, 2 H), 1.76~1.64 (m, 4 H), 1.16~1.33 (m, 6 H), 1.05 (t, $J = 7.2$ Hz, 3 H); ^{13}C NMR (125 MHz, CDCl_3): δ 202.7, 201.3, 43.1, 30.2, 27.6, 25.7, 25.3, 6.8 ; HRMS calcd for $\text{C}_{10}\text{H}_{16}\text{O}_2$: 168.1150, Found: 168.1152.

1-(3-Butyl-oxiranyl)-nonan-1-one : 5f

$R_f = 0.57$ (ether:hexane =1:3); IR (neat, cm^{-1}): 3033(w), 1719(s), 1618(w); ^1H NMR (400 MHz, CDCl_3): δ 3.17 (d, $J = 1.6$, Hz, 1 H), 3.00 (dt, $J = 5.6, 2.0$ Hz, 1 H), 2.43~2.35 (m, 1 H), 2.28~2.20 (m, 1 H), 1.63~1.52 (m, 4 H), 1.47~1.41 (m, 4 H), 1.39~1.06 (m, 10 H), 0.891 (t, $J = 7.2$ Hz, 3 H), 0.841 (t, $J = 7.2$ Hz, 3 H); ^{13}C NMR (125 MHz, CDCl_3): δ 207.0, 59.5, 58.2, 37.4, 31.7, 31.4, 29.2, 29.1, 29.0, 27.8, 23.5, 22.5, 22.2, 14.0, 13.8 ; HMRS calcd for $\text{C}_{15}\text{H}_{28}\text{O}_2$: 240.2089, Found : 240.2091

Pentadecane-6,7-dione: 6f

$R_f=0.56$ (ether:hexane=1:3); IR (neat, cm^{-1}): 3031(w), 1722(s), 1618(w); ^1H NMR (400 MHz, CDCl_3): δ 2.69 (t, $J = 7.2$, Hz, 4 H), 1.59~1.52 (m, 4 H), 1.28~1.23 (m, 14 H), 0.893~0.858 (qt, $J = 6.8$ Hz, 6 H); ^{13}C NMR (100 MHz, CDCl_3): δ 200.1, 36.0, 36.0, 31.7, 31.2, 29.2, 29.1, 29.0, 23.0, 22.7, 22.6, 22.3, 14.0, 13.8 ; HMRS calcd for $\text{C}_{15}\text{H}_{28}\text{O}_2$: 240.2089, Found : 240.2092.

1-(3-Hexyl-oxiranyl)-2-methyl-propan-1-one: 5g

$R_f = 0.55$ (ether:hexane =1:3); IR (neat, cm^{-1}): 3028(w), 1718(s), 1618(w); ^1H NMR (500 MHz, CDCl_3): δ 3.24 (d, $J = 2.0$ Hz, 1 H), 2.94 (dt, $J = 5.6, 2.0$ Hz, 1 H), 2.70~2.64 (m, 1 H), 1.63~1.55 (m, 2 H), 1.42~1.38 (m, 2 H), 1.37~1.20 (m, 6 H), 1.07 (d, $J = 7.0$, 3 H), 1.03 (d, $J = 6.5$ Hz, 3 H), 0.846 (t, $J = 6.5$ Hz, 3 H); ^{13}C NMR (125 MHz CDCl_3): δ 210.5, 58.6, 58.2, 36.0, 31.8, 31.5, 28.8, 25.6, 22.4, 18.1, 17.2, 13.9; HMRS calcd for $\text{C}_{15}\text{H}_{28}\text{O}_2$: 198.1620, Found : 198.1624.

2-Methyl-undecane-3,4-dione: 6g

$R_f = 0.58$ (ether:hexane =1:3); IR (neat, cm^{-1}): 3026(w), 1732(s), 1712(s), 1617(w); ^1H NMR (600 MHz, CDCl_3): δ 3.35~3.33 (m, 1 H), 2.70 (t, $J = 7.5$ Hz, 2 H), 1.56~1.54 (m, 2 H), 1.28~1.25 (m, 8 H), 1.07 (s, 3 H), 1.06 (s, 3 H), 0.857 (t, $J = 7.0$ Hz, 3 H); ^{13}C NMR (150 MHz, CDCl_3): δ 203.4, 200.8, 36.8, 31.9, 29.6, 29.5, 29.4, 29.3, 29.1, 23.0, 22.6, 17.3, 14.1; HMRS calcd for $\text{C}_{12}\text{H}_{22}\text{O}_2$: 198.1620, Found : 198.1622.

1-(3-Butyl-oxiranyl)-2,2-dimethyl-propan-1-one: 5h

$R_f = 0.55$ (ether:hexane =1:3); IR (neat, cm^{-1}): 3025(w), 2945(m), 1721(s), 1619(w); ^1H NMR (400 MHz, CDCl_3): δ 3.58 (d, $J = 2.4$ Hz, 1 H), 2.88 (dt, $J = 5.6, 2.4$ Hz, 1 H),

1.62~1.57 (m, 2 H), 1.43~1.32 (m, 4 H), 1.20 (s, 9 H), 0.873 (t, $J = 7.2$ Hz, 3 H); ^{13}C NMR (100 MHz, CDCl_3): δ 209.4, 59.9, 55.2, 43.4, 31.5, 27.7, 25.7, 22.3, 13.7, 18.1, 17.2, 13.9 ; HMRS calcd for $\text{C}_{13}\text{H}_{20}\text{O}_2$: 184.1463. Found : 184.1466.

2,2-Dimethyl-nonane-3,4-dione: 6h

$R_f = 0.58$ (ether:hexane=1:3); IR (neat, cm^{-1}): 3023(w), 2950(m), 1735(s), 1714(s), 1620(w); ^1H NMR (600 MHz, CDCl_3): δ 2.62 (t, $J = 7.4$ Hz, 2 H), 1.58~1.55 (m, 2 H), 1.30~1.27 (m, 4 H), 1.22 (s, 9 H), 0.878 (t, $J = 7.2$ Hz, 3 H); ^{13}C NMR (150 MHz, CDCl_3): δ 208.0, 203.3, 42.0, 38.7, 31.2, 22.39, 22.36, 13.8; HMRS calcd for $\text{C}_{11}\text{H}_{20}\text{O}_2$: 184.1463. Found : 184.1464.

1-(3-Phenyl-oxiranyl)-heptan-1-one: 5i

$R_f = 0.52$ (ether:hexane=1:3); IR (neat, cm^{-1}): 3022(w), 2948(m), 1717(s), 1619(w); ^1H NMR (400 MHz, CDCl_3): δ 7.36~7.32 (m, 3 H), 7.27~7.24 (m, 2 H), 3.94 (d, $J = 2.0$ Hz, 1H), 3.49 (d, $J = 1.62$ Hz, 1 H), 2.55 ~ 2.44 (m, 1 H), 2.42~2.36 (m, 1H), 1.62~1.56 (m, 2H), 1.31~1.23 (m, 6H), 0.867 (t, $J = 6.8$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 206.0, 135.2, 128.9, 128.6, 125.6, 63.1, 57.9, 37.7, 31.4, 28.7, 23.0, 22.4, 13.9; HMRS calcd for $\text{C}_{15}\text{H}_{20}\text{O}_2$: 232.1463, Found : 232.1465.

1-(3,3-Dimethyl-oxiranyl)-pentadecan-1-one: 5k

$R_f = 0.51$ (ether:hexane=1:3); IR (neat, cm^{-1}): 3027(w), 2949(m), 1716(s), 1616(w); ^1H NMR (500 MHz, CDCl_3): δ 3.35 (s, 1 H), 2.45 (t, $J = 8.0$ Hz, 2 H), 1.57~1.50 (m, 2 H), 1.38 (s, 6 H), 1.25~1.20 (m, 22 H), 0.828 (t, $J = 7.5$ Hz, 3 H); ^{13}C NMR (125 MHz, CDCl_3): δ 206.5, 65.2, 60.8, 40.8, 31.8, 29.56, 29.50, 29.3, 29.2, 29.1, 24.6, 23.1, 22.6, 18.2, 14.0; HMRS Calcd for $\text{C}_{19}\text{H}_{36}\text{O}_2$: 296.2715. Found: 296.2718.

2-Methyl-octadecane-3,4-dione: 6k

$R_f = 0.55$ (ether:hexane=1:3); IR (neat, cm^{-1}): 3024(w), 2943(m), 1732(s), 1712(s), 1619(w); ^1H NMR (600 MHz, CDCl_3): δ 3.35~3.33 (m, 1 H), 2.70 (t, $J = 7.5$ Hz, 2 H), 1.56~1.54 (m, 2 H), 1.28~1.25 (m, 22 H), 1.07 (s, 3 H), 1.06 (s, 3 H), 0.857 (t, $J = 7.0$ Hz, 3 H); ^{13}C NMR (150 MHz, CDCl_3): δ 203.4, 200.8, 36.8, 31.9, 29.6, 29.5, 29.4, 29.3, 29.1, 23.0, 22.6, 17.3, 14.1; HRMS calcd For $\text{C}_{19}\text{H}_{36}\text{O}_2$: 296.2715, Found: 296.2717.

3,3-Dimethyl-oxiranyl)-phenyl-methanone 5j

$R_f = 0.56$ (ether:hexane = 1:3); IR (neat, cm^{-1}): 3031(w), 1722(s), 1620(w); ^1H NMR (400MHz, CDCl_3): δ 7.95(d, $J = 7.4$ Hz, 2H), 7.60(t, $J = 7.4$ Hz, 1H), 7.49(t, $J = 7.4$ Hz, 2H), 4.03(s, 1H), 1.57(s, 3H), 1.23(s, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 194.1, 135.5,

133.7, 128.7, 128.0, 64.3, 61.1, 24.2, 18.3; HMRS calcd for $C_{11}H_{12}O_2$: 176.0837, Found : 176.0839.

3-Methyl-1-phenyl-butane-1,2-dione 6j

R_f=0.76 (ether:hexane = 1:3); IR (neat, cm^{-1}): 3030(w), 1738(s), 1721(s), 1618(w); 1H NMR (400MHz, $CDCl_3$): δ 7.90(d, J = 7.6 Hz, 2H), 7.61(t, J = 7.6 Hz, 1H), 7.47(t, J = 7.6 Hz, 2H), 3.35~3.25(m, 1H), 1.18(s, 3H), 1.16(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 206.6, 194.0, 134.5, 132.5, 130.1, 129.8, 128.8, 128.4, 36.5, 16.8, 16.8; HMRS calcd for $C_{11}H_{12}O_2$: 176.0837, Found : 172.0838.

[9-(2-Oxiranyl-2-oxo-ethyl)-9H-fluoren-9-yl]-acetaldehyde 7a

R_f = 0.46 (ether:hexane = 1:3); IR (neat, cm^{-1}): 3031(w), 1728(s), 1619(w); 1H NMR (400MHz, $CDCl_3$): δ 8.77(t, J = 3.0 Hz, 1H), 7.69(dd, J = 7.2, 4.4 Hz, 2H), 7.52(d, J = 7.2 Hz, 1H), 7.45(d, J = 7.2 Hz, 1H), 7.35~7.23(m, 4H), 3.22(d, J = 14.8 Hz, 1H), 3.09(d, J = 3.0 Hz, 2H), 2.95(d, J = 15.6 Hz, 1H), 2.93(dd, J = 4.4, 2.0 Hz, 1H), 2.44(t, J = 6.0 Hz, 1H), 2.16(d, J = 6.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 203.7, 201.5, 146.9, 146.7, 140.5, 140.2, 127.5, 127.4, 127.3, 127.2, 123.2, 122.9, 118.7, 118.7, 52.8, 51.7, 50.8, 45.0, 40.5; HMRS calcd for $C_{19}H_{16}O_3$: 292.1099, Found : 292.1101.

[9-(2,3-Dioxo-butyl)-9H-fluoren-9-yl]-acetaldehyde 8a

IR (neat, cm^{-1}): 3031(w), 1738(s), 1720(s), 1620(w); R_f =0.63 (ether:hexane = 1:3); ^1H NMR (400MHz, CDCl_3): δ 8.75(t, J = 3.0 Hz, 1H), 7.70(d, J = 7.2 Hz, 2H), 7.43(d, J = 7.2 Hz, 2H), 7.40~7.31(m, 4H), 3.59(s, 2H), 3.19(d, J = 3.0 Hz, 2H), 1.61(s, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ 201.5, 198.5, 196.9, 147.5, 140.7, 127.9, 127.8, 123.2, 120.2, 50.0, 51.4, 43.5, 27.5; HMRS calcd for $\text{C}_{19}\text{H}_{16}\text{O}_3$: 292.1099, Found : 292.1100.

2-[9-(2-Hydroxy-ethyl)-9H-fluoren-9-yl]-1-oxiranyl-ethanone 7b

R_f =0.26 (ether:hexane = 1:3); IR (neat, cm^{-1}): 3045(br s), 3033(w), 1724(s), 1620(w); ^1H NMR (400MHz, CDCl_3): δ 7.68(dd, J = 7.2, 3.2 Hz, 2H), 7.50(d, J = 7.2 Hz, 1H), 7.42(d, J = 7.2 Hz, 1H), 7.37~7.27(m, 4H), 3.19(d, J = 14.4 Hz, 1H), 3.01(d, J = 7.2 Hz, 1H), 2.96(d, J = 14.4 Hz, 1H), 2.93~2.91(m, 2H), 2.47(dd, J = 6.4, 5.2 Hz, 1H), 2.44~2.35(m, 2H), 2.19(dd, J = 6.4, 2.8 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ 203.6, 148.2, 148.1, 140.1, 139.8, 127.4, 127.4, 127.2, 127.1, 123.3, 123.1, 119.8, 119.7, 58.9, 52.9, 50.6, 46.9, 45.7, 41.1; HMRS calcd for $\text{C}_{19}\text{H}_{18}\text{O}_3$: 294.1256, Found : 294.1259.

1-[9-(2-Hydroxy-ethyl)-9H-fluoren-9-yl]-butane-2,3-dione 8b

R_f=0.47 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3031(w), 1738(s), 1718(s), 1620(w); ¹H NMR (400MHz, CDCl₃): δ 7.67(d, *J* = 7.6 Hz, 2H), 7.43(d, *J* = 7.6 Hz, 2H), 7.37~7.29(m, 4H), 3.47(s, 2H), 3.01(t, *J* = 7.4 Hz, 2H), 2.35(t, *J* = 7.4 Hz, 2H), 1.56(s, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 198.6, 196.9, 147.2, 147.2, 140.4, 140.4, 127.8, 127.7, 127.2, 127.1, 124.1, 124.0, 120.0, 119.6, 58.9, 51.2, 44.7, 42.0, 22.6; HMRS calcd for C₁₉H₁₈O₃ : 294.1256, Found : 294.1257.

2-[9-(2-[1,3]Dioxolan-2-yl-ethyl)-9H-fluoren-9-yl]-1-oxiranyl-ethanone 7c

R_f=0.31 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3030(w), 1722(s), 1620(w); ¹H NMR (400MHz, CDCl₃): δ 7.69~7.66(m, 2H), 7.47(d, *J* = 7.6 Hz, 1H), 7.39(d, *J* = 7.6 Hz, 1H), 7.36~7.28(m, 4H), 4.58(t, *J* = 4.4 Hz, 1H), 3.82~3.79(m, 2H), 3.72~3.69(m, 2H), 3.18(d, *J* = 14.8 Hz, 1H), 2.93(d, *J* = 11.6 Hz 1H), 2.91(t, *J* = 2.2 Hz, 1H), 2.45(t, *J* = 5.4 Hz, 1H), 2.31~2.20(m, 2H), 2.16(dd, *J* = 5.6, 2.4 Hz, 1H), 0.94~0.89(m, 2H); ¹³C NMR (100 MHz, CDCl₃): δ 203.6, 147.8, 147.7, 140.0, 140.0, 127.5, 127.4, 127.3, 127.2, 123.1, 122.9, 119.7, 119.7, 103.7, 64.3, 64.3, 52.8, 51.7, 47.0, 45.9, 32.8, 27.6; HMRS calcd for C₂₂H₂₂O₄ : 350.1518, Found: 350.1520.

1-[9-(2-[1,3]Dioxolan-2-yl-ethyl)-9H-fluoren-9-yl]-butane-2,3-dione 8c

R_f=0.47 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3030(w), 1736(s), 1712(s), 1620(w); ¹H NMR (400MHz, CDCl₃): δ 7.66(d, *J* = 7.2 Hz, 2H), 7.39(d, *J* = 7.2 Hz, 2H), 7.36~7.28(m, 4H), 4.58(t, *J* = 5.6 Hz, 1H), 3.81~3.79(m, 2H), 3.73~3.71(m, 2H), 3.45(s, 2H), 2.24~2.20(m, 2H), 1.55(s, 3H), 0.95~0.90(m, 2H); ¹³C NMR (100 MHz, CDCl₃): δ 198.5, 196.9, 147.0, 140.7, 127.8, 127.5, 123.8, 119.9, 103.9, 64.6, 52.3, 44.4, 33.4, 27.7, 22.5; HMRS calcd for C₂₂H₂₂O₄: 350.1518, Found: 350.1520.

2-(1-Allyl-2-propenyl-1*H*-inden-1-yl)-1-oxiranyl-ethanone 7d

R_f=0.50 (ether:hexane = 1:3); IR (neat, cm⁻¹): 3031(w), 1728(s), 1645(w), 1620(w); ¹H NMR (400MHz, CDCl₃): δ 7.71(dd, *J* = 7.6, 3.6 Hz, 2H), 7.52(d, *J* = 7.6 Hz, 1H), 7.43(d, *J* = 7.6 Hz, 1H), 7.38~7.28(m, 4H), 5.35~5.25(m, 1H), 4.91~4.82(m, 2H), 3.19(d, *J* = 15.6 Hz, 1H), 2.95(d, *J* = 15.6 Hz, 1H), 2.95(d, *J* = 2.8 Hz, 1H), 2.79(d, *J* = 7.2 Hz, 2H), 2.47(dd, *J* = 6.0, 5.2 Hz, 1H), 2.19(dd, *J* = 6.4, 2.0 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃): δ 204.0, 148.2, 148.1, 140.2, 140.2, 132.7, 127.5, 127.4, 127.1, 127.0, 123.5, 123.5, 119.8, 119.8, 118.3, 52.9, 51.8, 46.0, 45.7, 43.2; HMRS calcd for C₂₀H₁₈O₂: 290.1307, Found: 290.1310.

1-(1-Allyl-5-allylidene-2-propenyl-cyclopent-2-enyl)-butane-2,3-dione

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