

Sulfur-assisted Five-cascade Sequential Reactions for the Convenient and
Efficient Synthesis of Allyl Thiophen-2-yl Acetates, Propionates and
Ketones.

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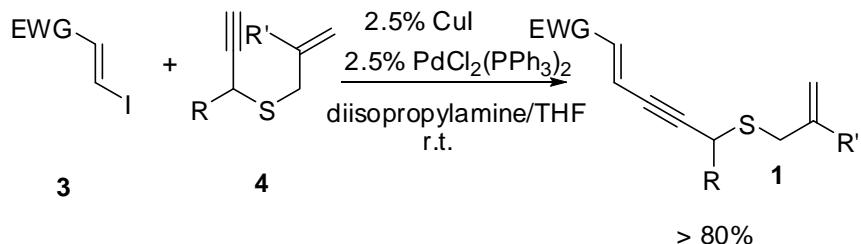
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General experimental procedures

All ^1H NMR spectra were measured in CDCl_3 and recorded on Bruker Avance-400 (400 MHz) spectrometer with TMS as the internal standard. ^{13}C NMR spectra were measured in CDCl_3 and recorded on Bruker Avance-400 (100 MHz) or Bruker Avance-500 (125 MHz) spectrometer with TMS as the internal standard. Chemical shifts are expressed in ppm and J values are given in Hz. IR spectra were run on a Bruker vector 22 spectrometer. EIMS were determined with a HP5989B mass spectrometer. All the reactions in this paper were performed under nitrogen atmosphere.

General procedure for the synthesis of substrates (**1a-1t**)

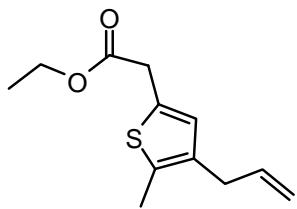


The substrates (**1a-1u**) could be easily prepared via a Sonogashira reaction using iodoethenes (**3**) and allyl propargyl sulfanes (**4**) as the materials: to a solution of **3** (2.0 mmol) and **4** (2.4 mmol) in 10 mL of THF was added CuI (10 mg, 0.05 mmol) and $\text{PdCl}_2(\text{PPh}_3)_2$ (35mg, 0.05mmol), then added 1 mL of diisopropylamine under a nitrogen atmosphere at room temperature for 1 h. The reaction mixture was quenched with water, extracted with diethyl ether, and dried over anhydrous Na_2SO_4 . After evaporation of the diethyl ether,

chromatography on silica gel (eluent: EtOAc/petroleum ether = 1:20) of the crude product afforded **1**, generally in a yield higher than 80%.

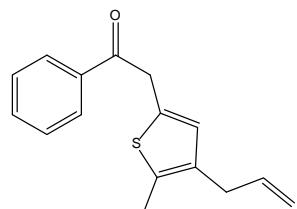
Typical procedure for synthesis of allyl-thiophenes (2). To a solution of ethyl 6-(allylthio) hept-2-en-4-ynoate (**1a**, 0.5 mmol) in 2 mL of THF was added 0.6 mmol of DBU under a nitrogen atmosphere at room temperature for 1 h. The reaction mixture was quenched with 20 mL of water, extracted with dichloromethane, and dried over anhydrous Na₂SO₄. After evaporation of the dichloromethane, chromatography on silica gel (eluent: petroleum ether/EtOAc = 20:1) of the crude product afforded the desired product **2a** in a yield of 63%.

NOTE: Although generally the procedure does not need to be heated, a temperature lower than 25 °C might prolong the reaction time. Furthermore, although the products allyl-thiophenes are considerably stable in air, they could be oxidized by oxygen in the presence of DBU.



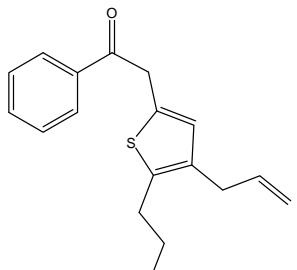
Compound 2a:

Yield: 63%, 70 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 6.62 (s, 1H), 5.91–5.83 (m, 1H), 5.03–4.99 (m, 2H), 4.20–4.15 (q, $J = 6.8$ Hz, 2H), 3.69 (s, 2H), 3.22–3.21 (d, $J = 6.4$ Hz, 2H), 2.31 (s, 3H), 1.29–1.26 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (CDCl_3 , 125 MHz) δ 170.6, 136.5, 134.8, 133.0, 130.6, 128.8, 115.2, 61.0, 35.6, 32.7, 14.1, 12.8. MS (m/z) 224 (M, 27), 225 (M + 1, 5); IR (neat, cm^{-1}): 2979.5, 2918.4, 1737.3, 1159.7, 1029.8. HRMS calcd for $\text{C}_{12}\text{H}_{16}\text{O}_2\text{S}$: 224.0871. Found: 224.0879.



Compound 2b:

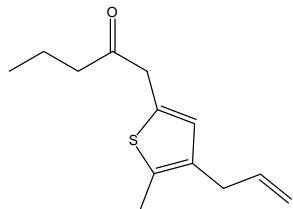
Yield: 68%, 87 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 8.03–8.01 (m, 2H), 7.60–7.58 (m, 1H), 7.50–7.46 (m, 2H), 6.63 (s, 1H), 5.91–5.83 (m, 1H), 5.02–4.98 (m, 2H), 4.36(s, 2H), 3.22–3.21 (d, $J = 6.0$ Hz, 2H), 2.31 (s, 3H); ^{13}C NMR (CDCl_3 , 125 MHz) δ 196.2, 136.6, 136.4, 135.1, 133.3, 133.2, 131.0, 128.9, 128.7, 128.6, 115.2, 39.6, 32.7, 12.8. MS (m/z) 256 (M, 25), 257 (M + 1, 5); IR (neat, cm^{-1}): 2930.7, 2921.9, 1675.7, 694.8. HRMS calcd for $\text{C}_{16}\text{H}_{16}\text{OS}$: 256.0922. Found: 256.0930.



Compound 2c:

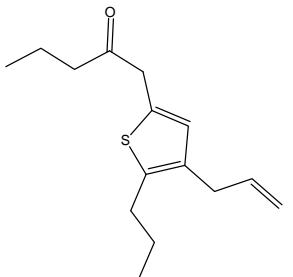
Yield: 65%, 92mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 8.02–8.00 (m, 2H), 7.59–7.55 (m, 1H), 7.49–7.45 (m, 2H), 6.62 (s, 1H), 5.91–5.83 (m, 1H), 5.01–4.98 (m, 2H), 4.36(s, 2H), 3.22–3.20 (d, $J = 6.4$ Hz, 2H), 2.66–2.62 (t, $J = 7.8$ Hz, 2H), 1.65–1.58 (m, 2H), 0.97–0.93 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 196.2, 139.2,

136.9, 136.2, 134.5, 133.2, 131.1, 128.7, 128.6, 128.6, 115.2, 39.5, 32.6, 29.8, 24.8, 13.8. MS (m/z) 284 (M, 30), 285 (M + 1, 6); IR (neat, cm⁻¹): 2960.5, 2928.9, 1677.7, 687.8. HRMS calcd for C₁₈H₂₀OS: 284.1235. Found: 284.1222.



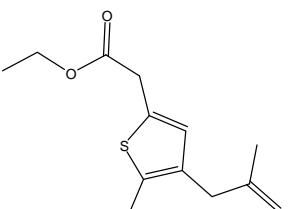
Compound 2d:

Yield: 60%, 66 mg; oil; ¹H NMR (400 MHz, CDCl₃) δ 6.55 (s, 1H), 5.89–5.83 (m, 1H), 5.04–4.96 (m, 2H), 3.72 (s, 2H), 3.21–3.19 (d, *J* = 6.4 Hz, 2H), 2.46–2.43 (t, *J* = 7.0 Hz, 2H), 2.29 (s, 3H), 1.64–1.54 (m, 2H), 0.90–0.86 (t, *J* = 7.4 Hz, 3H); ¹³C NMR (CDCl₃, 100 MHz) δ 207.1, 136.4, 135.0, 133.0, 130.8, 128.7, 115.1, 43.7, 43.4, 32.6, 17.1, 13.5, 12.7. MS (m/z) 222 (M, 18), 223 (M + 1, 4); IR (neat, cm⁻¹): 2961.4, 2922.6, 1713.4. HRMS calcd for C₁₃H₁₈OS: 222.1078. Found: 222.1070.



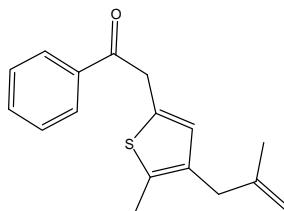
Compound 2e:

Yield: 70%, 87 mg; oil; ¹H NMR (400 MHz, CDCl₃) δ 6.53 (s, 1H), 5.88–5.81 (m, 1H), 4.98–4.94 (m, 2H), 3.70 (s, 2H), 3.19–3.17 (d, *J* = 6.0 Hz, 2H), 2.62–2.59 (t, *J* = 7.4 Hz, 2H), 2.43–2.41 (t, *J* = 5.8 Hz, 2H), 1.63–1.51 (m, 4H), 0.93–0.89 (t, *J* = 7.2 Hz, 3H), 0.87–0.83 (t, *J* = 7.4 Hz, 3H); ¹³C NMR (CDCl₃, 100 MHz) δ 207.2, 139.1, 136.9, 134.6, 131.0, 128.7, 115.2, 43.8, 43.4, 32.6, 29.7, 24.8, 17.1, 13.8, 13.6. MS (m/z) 250 (M, 98), 251 (M + 1, 26); IR (neat, cm⁻¹) 2960.8, 2931.5, 1713.3, 911.6. C₁₅H₂₂OS: 250.1391. Found: 250.1382.



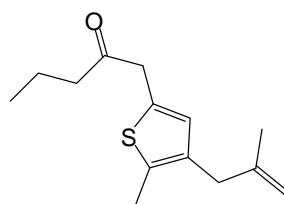
Compound 2f:

Yield: 73%, 86 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 6.59 (s, 1H), 4.75 (s, 1H), 4.64 (s, 1H), 4.19–4.14 (q, $J = 7.2$ Hz, 2H), 3.69 (s, 2H), 3.15 (s, 2H), 2.29 (s, 3H), 1.68 (s, 3H), 1.28–1.25 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 170.7, 144.3, 134.8, 133.4, 130.3, 129.1, 111.0, 61.0, 36.7, 35.6, 22.2, 14.1, 12.8. MS (m/z) 238 (M, 97), 239 (M + 1, 35); IR (neat, cm^{-1}) 2977.4, 2916.7, 1737.1, 1157.9. HRMS calcd for $\text{C}_{13}\text{H}_{18}\text{O}_2\text{S}$: 238.1028. Found: 238.1024.



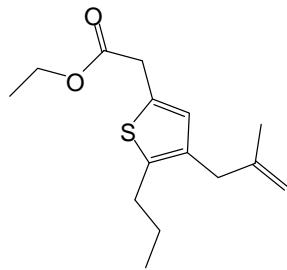
Compound **2g**:

Yield: 62%, 83 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 8.02–8.00 (m, 2H), 7.58–7.55 (m, 1H), 7.48–7.44 (m, 2H), 6.60 (s, 1H), 4.73 (s, 1H), 4.62 (s, 1H), 4.35 (s, 2H), 3.14 (s, 2H), 2.29 (s, 3H), 1.67 (s, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 196.2, 144.3, 136.1, 134.9, 133.5, 133.2, 130.6, 129.2, 128.6, 128.5, 111.0, 39.6, 36.7, 22.2, 12.8. MS (m/z) 271 (M + 1, 5), 270 (M, 20); IR (neat, cm^{-1}) 2916.5, 1681.6, 688.1. HRMS calcd for $\text{C}_{17}\text{H}_{18}\text{OS}$: 270.1078. Found: 270.1088.



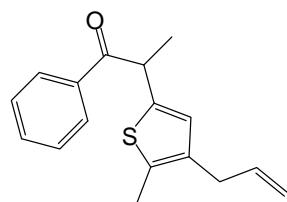
Compound **2h**:

Yield: 71%, 83 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 6.56 (s, 1H), 4.77 (s, 1H), 4.65 (s, 1H), 3.75 (s, 2H), 3.17 (s, 2H), 2.50–2.46 (t, $J = 7.2$ Hz, 2H), 2.32 (s, 3H), 1.70 (s, 3H), 1.64–1.59 (q, $J = 7.5$ Hz, 2H), 0.93–0.89 (t, $J = 7.6$ Hz, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 207.2, 144.3, 135.0, 133.4, 130.6, 129.1, 111.0, 43.8, 43.4, 36.7, 22.2, 17.2, 13.6, 12.8. MS (m/z) 237 (M + 1, 26), 236 (M, 98); IR (neat, cm^{-1}) 2963.5, 2929.9, 1713.6, 889.1. HRMS calcd for $\text{C}_{14}\text{H}_{20}\text{OS}$: 236.1235. Found: 236.1231.



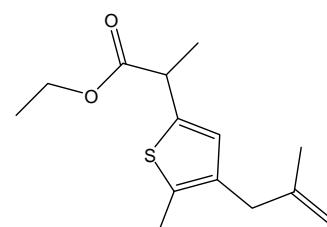
Compound **2i**:

Yield: 80%, 106 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 6.57 (s, 1H), 4.73 (s, 1H), 4.62 (s, 1H), 4.17–4.12 (q, $J = 6.9$ Hz, 2H), 3.68 (s, 2H), 3.14 (s, 2H), 2.64–2.60 (t, $J = 7.8$ Hz, 2H), 1.66 (s, 3H), 1.64–1.58 (q, $J = 7.6$ Hz, 2H), 1.26–1.22 (t, $J = 7.2$ Hz, 3H), 0.96–0.92 (t, $J = 7.4$ Hz, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 170.7, 144.6, 139.5, 134.2, 130.5, 129.0, 111.2, 60.9, 36.7, 35.6, 29.8, 24.8, 22.3, 14.1, 13.8. MS (m/z) 267 (M + 1, 12), 266 (M, 28), 265 (M - 1, 98); IR (neat, cm^{-1}) 2963.5, 2931.7, 1736.1, 1155.7. HRMS calcd for $\text{C}_{15}\text{H}_{22}\text{O}_2\text{S}$: 266.1341. Found: 266.1338.



Compound **2j**:

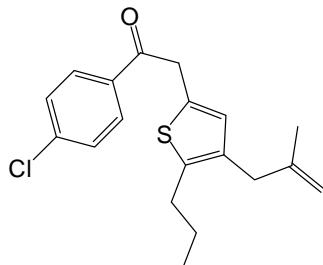
Yield: 62%, 83 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 7.99–7.95 (m, 2H), 7.94–7.50 (m, 1H), 7.47–7.41 (m, 2H), 6.55 (s, 1H), 5.87–5.77 (m, 1H), 4.98–4.91 (m, 2H), 4.87–4.81 (q, $J = 6.8$ Hz, 1H), 3.16–3.14 (d, $J = 6.4$ Hz, 2H), 2.25 (s, 3H), 1.56–1.55 (d, $J = 7.2$ Hz, 3H); ^{13}C NMR (CDCl_3 , 125 MHz) δ 199.2, 138.9, 136.5, 136.3, 135.0, 132.9, 128.8, 128.5, 128.0, 127.0, 115.2, 42.4, 32.7, 19.9, 12.8. MS (m/z) 271 (M + 1, 4), 270 (M, 21); IR(neat, cm^{-1}) 2921.0, 2850.8, 1683.8, 1220.8. HRMS calcd for $\text{C}_{14}\text{H}_{20}\text{OS}$: 270.1078. Found: 270.1083.



Compound **2k**:

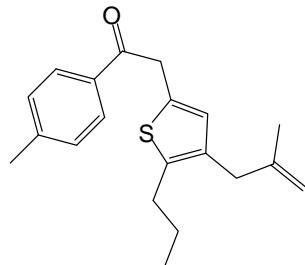
Yield: 65%, 82 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 6.58 (s, 1H), 4.74 (s, 1H), 4.63 (s, 1H), 4.17–4.12 (q, $J=7.1$, 2H), 3.87–3.81 (q, $J=7.2$, 1H), 3.14 (s, 2H), 2.21 (s, 3H), 1.68 (s, 3H), 1.52–1.50 (d, $J=7.2$, 3H), 1.26–1.22 (t, $J=6.8$, 3H). ^{13}C NMR (CDCl_3 , 125

MHz) δ 173.7, 144.4, 138.1, 134.6, 132.6, 127.1, 111.1, 60.9, 41.0, 36.9, 22.2, 19.1, 14.1, 12.7. MS (m/z) 252 (M, 18), 179(M-73, 100); IR (neat, cm⁻¹) 2979.3, 2930.6, 1735.8, 1178.4. HRMS calcd for C₁₄H₂₀O₂S: 252.1184. Found: 252.1176.



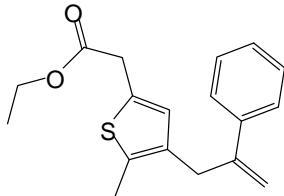
Compound 2l:

Yield: 63%, 104 mg; oil; ¹H NMR (400 MHz, CDCl₃) δ 7.97–7.94 (m, 2H), 7.45–7.43 (m, 2H), 6.59 (s, 1H), 4.75 (s, 1H), 4.62 (s, 1H), 4.33 (s, 2H), 3.16 (s, 2H), 2.66–2.62 (t, *J* = 7.6 Hz, 2H), 1.68 (s, 3H), 1.66–1.60 (q, *J* = 7.5 Hz, 2H), 0.98–0.94 (t, *J* = 7.2 Hz, 3H); ¹³C NMR (CDCl₃, 100 MHz) δ 195.1, 144.5, 139.9, 139.7, 134.5, 134.4, 130.4, 130.0, 129.2, 128.9, 111.2, 39.7, 36.7, 29.8, 24.8, 22.2, 13.8. MS (m/z) 332 (M, 10), 334 (M + 2, 3); IR (neat, cm⁻¹) 2961.5, 2929.8, 1680.3, 1091.0. HRMS calcd for C₁₉H₂₁ClOS: 332.1002. Found: 332.1008.



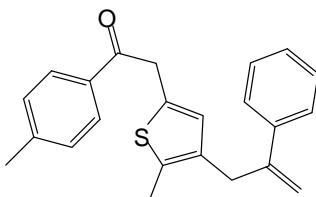
Compound 2m:

Yield: 78%, 121 mg; oil; ¹H NMR (400 MHz, CDCl₃) δ 7.92–7.90 (m, 2H), 7.26–7.24 (m, 2H), 6.59 (s, 1H), 4.74 (s, 1H), 4.62 (s, 1H), 4.32 (s, 2H), 3.15 (s, 2H), 2.65–2.61 (t, *J* = 7.8 Hz, 2H), 2.40 (s, 3H), 1.67 (s, 3H), 1.65–1.59(q, *J* = 7.5 Hz, 2H), 0.97–0.93 (t, *J* = 7.4 Hz, 3H); ¹³C NMR (CDCl₃, 100 MHz) δ 195.9, 144.6, 144.0, 139.6, 134.3, 133.7, 131.2, 129.3, 128.9, 128.7, 111.2, 39.5, 36.7, 29.8, 24.8, 22.3, 21.6, 13.9. MS (m/z) 312 (M, 13); IR(neat, cm⁻¹) 2960.3, 2910.5, 1670.4, 890.3. Anal. Calc. for C₂₀H₂₄OS: C, 76.88; H, 7.74. Found: C, 76.55; H, 7.56%.



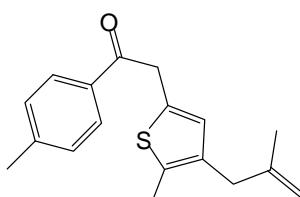
Compound 2n:

Yield: 68%, 102 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 7.46–7.43 (m, 2H), 7.35–7.31 (m, 2H), 7.29–7.26 (m, 1H), 6.63 (s, 1H), 5.42 (s, 1H), 4.93 (s, 1H), 4.20–4.15 (q, $J = 7.0$ Hz, 2H), 3.69 (s, 2H), 3.64 (s, 2H), 2.33 (s, 3H), 1.29–1.25 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 170.7, 146.3, 141.2, 134.5, 133.5, 130.4, 129.2, 128.2, 127.4, 125.9, 113.5, 61.0, 35.6, 34.0, 14.1, 12.9. MS (m/z) 301 (M + 1, 4), 300 (M, 18); IR (neat, cm^{-1}) 2980.3, 1734.5, 1157.8. HRMS calcd for $\text{C}_{18}\text{H}_{20}\text{O}_2\text{S}$: 300.1184 Found: 300.1192



Compound 2o:

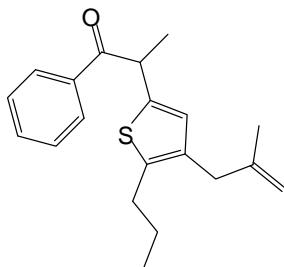
Yield: 66%, 114 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 7.90–7.88 (m, 2H), 7.43–7.40 (m, 2H), 7.33–7.24 (m, 5H), 6.60 (s, 1H), 5.38 (s, 1H), 4.90 (s, 1H), 4.30 (s, 2H), 3.62 (s, 2H), 2.42 (s, 3H), 2.30 (s, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 195.9, 146.3, 144.0, 141.1, 134.6, 133.6, 133.5, 131.1, 129.3, 129.2, 128.7, 128.2, 127.4, 125.9, 113.5, 39.5, 34.0, 21.6, 12.9. MS (m/z) 347 (M + 1, 3), 346 (M, 12); IR (neat, cm^{-1}) 2917.5, 1676.5. HRMS calcd for $\text{C}_{23}\text{H}_{22}\text{OS}$: 346.1391 Found: 346.1398



Compound 2p:

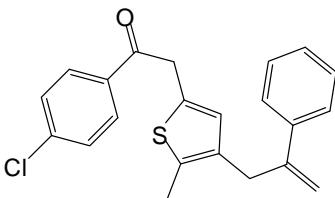
Yield: 62%, 88 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 7.92–7.90 (m, 2H), 7.27–7.25 (m, 2H), 6.59 (s, 1H), 4.73 (s, 1H), 4.62 (s, 1H), 4.32 (s, 2H), 3.14 (s, 2H), 2.41 (s, 3H), 2.28 (s, 3H), 1.67 (s, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 195.9, 144.3, 144.0, 134.9, 133.6, 133.4, 130.9, 129.3, 129.1, 128.7, 111.0, 39.5, 36.8, 22.2, 21.6, 12.8. MS (m/z) 284 (M, 52) 285 (M + 1, 10); IR(neat, cm^{-1}) 2918.5, 1676.3, 1180.5. HRMS

calcd for C₁₈H₂₀OS: 284.1235 Found: 284.1239.



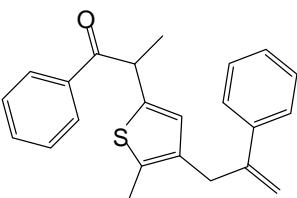
Compound **2q**:

Yield: 80%, 124 mg; oil; ¹H NMR (400 MHz, CDCl₃) δ 8.01–7.99 (m, 2H), 7.55–7.51 (m, 1H), 7.46–7.42 (m, 2H), 6.55 (s, 1H), 4.89–4.84 (q, *J* = 6.8 Hz, 1H), 47.2 (s, 1H), 4.57 (s, 1H), 3.12 (s, 2H), 2.63–2.60 (t, *J* = 7.6 Hz, 2H), 1.66–1.57 (m, 2H), 1.64 (s, 3H), 1.59–1.58 (d, *J* = 6.4 Hz, 3H), 0.96–0.93 (t, *J* = 7.2 Hz, 3H); ¹³C NMR (CDCl₃, 100 MHz) δ 199.3, 144.5, 139.2, 138.8, 136.2, 134.3, 132.9, 128.7, 128.4, 127.3, 111.1, 42.4, 36.7, 29.8, 24.7, 22.2, 19.8, 13.8. MS (m/z) 313 (M + 1, 16), 312 (M, 72); IR (neat, cm⁻¹) 2963.5, 2931.3, 1684.5, 1219.5. HRMS calcd for C₂₀H₂₄OS: 312.1548 Found: 312.1543



Compound **2r**:

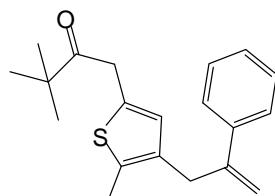
Yield: 60%, 110 mg; oil; ¹H NMR (400 MHz, CDCl₃) δ 7.92–7.89 (m, 2H), 7.42–7.39 (m, 4H), 7.32–7.26 (m, 3H), 6.58 (s, 1H), 5.38 (s, 1H), 4.90 (s, 1H), 4.29 (s, 2H), 3.62 (s, 2H), 2.31 (s, 3H); ¹³C NMR (CDCl₃, 100 MHz) δ 195.0, 146.2, 141.0, 139.6, 134.8, 134.4, 133.8, 130.4, 130.0, 129.3, 128.9, 128.2, 127.4, 125.9, 113.6, 39.7, 34.0, 12.9. MS (m/z) 368 (M + 2, 3), 366 (M, 8); IR (neat, cm⁻¹) 2919.7, 1682.2, 729.4. HRMS calcd for C₂₂H₁₉ClOS: 366.0845 Found: 366.0855



Compound **2s**:

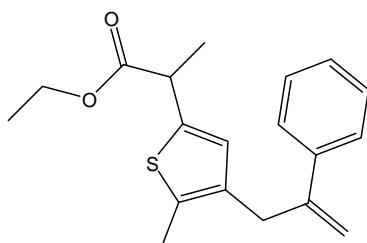
Yield: 66%, 114 mg; oil; ¹H NMR (400 MHz, CDCl₃) δ 7.99–7.97 (m, 2H), 7.56–7.52 (m, 1H), 7.45–7.41 (m, 1H), 7.39–7.36 (m, 2H), 7.32–7.26 (m, 3H), 6.58 (s, 1H), 6.35

(s, 1H), 4.84 (s, 1H), 4.87–4.82 (q, J = 6.9 Hz, 1H) 3.60 (s, 2H), 2.29 (s, 3H), 1.58–1.57 (d, J = 7.2 Hz, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 199.2, 146.3, 141.1, 138.8, 136.1, 134.6, 133.2, 132.9, 128.7, 128.5, 128.2, 127.6, 127.4, 126.0, 113.5, 42.5, 34.1, 19.8, 12.9. MS (m/z) 347 (M + 1, 4), 346 (M, 16); IR (neat, cm^{-1}) 2928.3, 1682.6, 701.1, 687.9. HRMS calcd for $\text{C}_{22}\text{H}_{19}\text{ClOS}$: 346.1391 Found: 346.1382



Compound 2t:

Yield: 63%, 98 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 7.41–7.39 (m, 2H), 7.26–7.31 (m, 2H), 7.25–7.24 (m, 1H), 6.51 (s, 1H), 5.37 (s, 1H), 4.89 (s, 1H), 3.84 (s, 2H), 3.60 (s, 2H), 2.29 (s, 3H), 1.15 (s, 9H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 211.6, 146.4, 141.2, 134.3, 133.3, 131.3, 128.9, 128.2, 127.4, 126.0, 113.5, 44.5, 37.4, 34.0, 26.3, 12.9. MS (m/z) 313 (M + 1, 6), 312 (M, 25); IR (neat, cm^{-1}) 2967.1, 1708.8, 701.7. Anal. Calc. for $\text{C}_{20}\text{H}_{24}\text{OS}$: C, 76.88; H, 7.74. Found: C, 76.47; H, 7.42%.



Compound 2u:

Yield: 62%, 97 mg; oil; ^1H NMR (400 MHz, CDCl_3) δ 7.43–7.41 (m, 2H), 7.33–7.29 (m, 2H), 7.27–7.24 (m, 1H), 6.61 (s, 1H), 5.38 (s, 1H), 4.89 (s, 1H), 4.16–4.10 (q, J =7.1, 2H), 3.85–3.80 (q, J =7.3, 1H), 3.61 (s, 2H), 2.30 (s, 3H), 1.50–1.48 (d, J =6.8, 3H), 1.24–1.20 (t, J =7.2, 3H); ^{13}C NMR (CDCl_3 , 100 MHz) δ 173.6, 146.3, 141.2, 138.2, 134.3, 132.8, 128.2, 127.4, 125.9, 113.5, 60.9, 40.9, 34.1, 19.1, 14.0, 12.9. MS (m/z) 315 (M + 1, 7), 314 (M, 31); IR (neat, cm^{-1}) 2979.9, 1731.8, 1177.1. HRMS calcd for $\text{C}_{19}\text{H}_{22}\text{O}_2\text{S}$: 314.1341. Found: 314.1339.

