Supporting Information

Enantioselective Synthesis of Quaternary \( \alpha \)-Aminophosphonates by Palladium-catalyzed Arylation of Cyclic \( \alpha \)-Ketiminophosphonates with Arylboronic Acids

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1. General

All reactions were carried out under an atmosphere of nitrogen using the standard Schlenk techniques, unless otherwise noted. Commercially available reagents were used without further purification. Solvents were treated prior to use according to the standard methods. $^1$H NMR, $^{13}$C NMR, $^{31}$P NMR and $^{19}$F NMR spectra were recorded at room temperature in CDCl$_3$ on 400 MHz instrument with tetramethylsilane (TMS) as internal standard. Optical rotations were measured with JASCO P-1010 polarimeter. Flash column chromatography was performed on silica gel (200-300 mesh). All reactions were monitored by TLC analysis. Cyclic $\alpha$-ketiminophosphonates 1a-1r and 3a-3e could be conveniently synthesized according to the known literature procedure.$^{[1]}$

2. General Procedure for Synthesis of $\alpha$-Ketiminophosphonates

$\alpha$-Ketiminophosphonates were synthesized according to the known literature procedure,$^{[1]}$ among them, 1a-f, 1j-r and 3a-e are the known compounds.

To a suspension of the corresponding benzoxathiazine-2,2-dioxide (25 mmol) and the corresponding dialkylphosphite (30 mmol) in toluene (50 mL) was added triethylamine (2.5 mmol). The solution was stirred and refluxed in toluene for 24 h until disappearance of benzoxathiazine-2,2-dioxide. The solution was allowed to cool to room temperature and purification was performed by a silica gel column eluted with dichloromethane to give pure product 7.

To a solution of the above product (1.0 mmol) in dichloromethane was added freshly prepared manganese dioxide (10 mmol) (the manganese dioxide must be freshly prepared, or the reaction yield will be low). The solution was stirred and refluxed at 50 °C for 4-8 h. The solution was allowed to cool to room temperature and purification was performed by a silica gel column eluted with dichloromethane to give pure product 1.

**Diisopropyl (6-fluoro-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (7g)**: The reaction was conducted by using 6-fluorobenzo[e][1,2,3]oxathiazine 2,2-dioxide (0.604 g, 3.0 mmol), affording 1.023 g (93% yield) of 7g as a white solid, m.p. = 151-152 °C, R$_f$ = 0.70 (petroleum ether/ethyl acetate 1/1). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.54 (d, $J$ = 9.1 Hz, 1H), 7.15-6.87 (m, 2H), 6.47 (s, 1H), 5.01 (d, $J$ = 21.1 Hz, 1H), 4.91-4.79 (m, 1H), 4.78-4.66 (m, 1H), 1.42-1.32 (m, 9H), 1.21 (d, $J$ = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 159.2 (dd, $J_{FC}$ = 245.1 Hz, $J_{PC}$ = 106.4 Hz).
Diisopropyl (6-chloro-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (7h): The reaction was conducted by using 6-chlorobenzo[e][1,2,3]oxathiazine 2,2-dioxide (0.653 g, 3.0 mmol), affording 0.995 g (86% yield) of 7h as a white solid, m.p. = 147-148 °C, Rf = 0.70 (petroleum ether/ethyl acetate 1:1). \( ^1H \) NMR (400 MHz, CDCl3) \( \delta \): 7.87 (s, 1H), 7.34-7.22 (m, 1H), 6.95 (d, \( J = 8.8 \) Hz, 1H), 6.60 (brs, 1H), 5.00 (d, \( J = 21.1 \) Hz, 1H), 4.91-4.79 (m, 1H), 4.78-4.65 (m, 1H), 1.42-1.36 (m, 6H), 1.34 (d, \( J = 6.2 \) Hz, 3H), 1.23 (d, \( J = 6.2 \) Hz, 3H); \( ^13C \) NMR (100 MHz, CDCl3) \( \delta \): 150.4 (d, \( J_{PC} = 8.9 \) Hz), 130.6 (d, \( J_{PC} = 2.6 \) Hz), 130.0 (d, \( J_{PC} = 1.8 \) Hz), 127.7 (d, \( J_{PC} = 3.0 \) Hz), 120.5, 118.3 (d, \( J_{PC} = 3.6 \) Hz), 74.2 (d, \( J_{PC} = 7.1 \) Hz), 74.0 (d, \( J_{PC} = 7.0 \) Hz), 54.1 (d, \( J_{PC} = 156.3 \) Hz), 24.2 (d, \( J_{PC} = 3.4 \) Hz), 24.1 (d, \( J_{PC} = 3.9 \) Hz), 23.9 (d, \( J_{PC} = 5.0 \) Hz), 23.7 (d, \( J_{PC} = 5.4 \) Hz); \( ^31P \) NMR (162 MHz, CDCl3) \( \delta \): 13.9. HRMS Calculated for C13H25ClNO4PS [M+H]+ 384.0342, found 384.0347.

Diisopropyl (6-bromo-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (7i): The reaction was conducted by using 6-bromobenzo[e][1,2,3]oxathiazine 2,2-dioxide (0.786 g, 3.0 mmol), affording 1.093 g (86% yield) of 7i as a white solid, m.p. = 133-134 °C, Rf = 0.70 (petroleum ether/ethyl acetate 1:1). \( ^1H \) NMR (400 MHz, CDCl3) \( \delta \): 7.91 (s, 1H), 7.43 (d, \( J = 8.7 \) Hz, 1H), 6.89 (d, \( J = 8.7 \) Hz, 1H), 6.76 (brs, 1H), 4.99 (d, \( J = 21.2 \) Hz, 1H), 4.91-4.79 (m, 1H), 4.78-4.64 (m, 1H), 1.44-1.36 (m, 6H), 1.34 (d, \( J = 6.2 \) Hz, 3H), 1.25 (d, \( J = 6.2 \) Hz, 3H); \( ^13C \) NMR (100 MHz, CDCl3) \( \delta \): 150.9 (d, \( J_{PC} = 8.9 \) Hz), 132.9 (d, \( J_{PC} = 1.7 \) Hz), 130.6 (d, \( J_{PC} = 3.0 \) Hz), 120.8, 118.7 (d, \( J_{PC} = 3.4 \) Hz), 118.0 (d, \( J_{PC} = 2.6 \) Hz), 74.2 (d, \( J_{PC} = 7.1 \) Hz), 74.0 (d, \( J_{PC} = 7.1 \) Hz), 54.0 (d, \( J_{PC} = 156.9 \) Hz), 24.3 (d, \( J_{PC} = 3.4 \) Hz), 24.1 (d, \( J_{PC} = 3.9 \) Hz), 23.9 (d, \( J_{PC} = 5.1 \) Hz), 23.7 (d, \( J_{PC} = 5.3 \) Hz); \( ^31P \) NMR (162 MHz, CDCl3) \( \delta \): 13.9. HRMS Calculated for C13H25BrNO4PS [M+H]+ 427.9927, found 427.9924.

Diisopropyl (6-fluoro-2,2-dioxidobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (1g): The reaction was conducted by using 7g (0.868 g, 2.4 mmol), affording 0.084 g (10% yield) of 1g as a white solid, m.p. = 71-72 °C, Rf = 0.40 (dichloromethane). \( ^1H \) NMR (400 MHz, CDCl3) \( \delta \): 8.32-8.20 (m, 1H), 7.53-7.42 (m, 1H), 7.37-7.29 (m, 1H), 5.03-4.85 (m, 2H), 1.49-1.38 (m, 12H); \( ^13C \) NMR (100 MHz, CDCl3) \( \delta \): 172.8 (dd, \( J_{PC} = 200.8 \) Hz, \( J_{FC} = 2.5 \) Hz), 159.1 (d, \( J_{FC} = 248.4 \) Hz), 150.4 (d, \( J_{FC} = 8.3 \) Hz, \( J_{PC} = 2.5 \) Hz), 125.1 (d, \( J_{PC} = 24.4 \) Hz), 120.9 (dd, \( J_{PC} = 8.0 \) Hz, \( J_{PC} = 3.1 \) Hz), 117.4 (d, \( J_{PC} = 26.3 \) Hz), 116.4 (dd, \( J_{PC} = 24.0 \) Hz, \( J_{PC} = 8.8 \) Hz), 75.5 (d, \( J_{PC} = 7.2 \) Hz), 24.1 (d, \( J_{PC} = 3.9 \) Hz), 23.9 (d, \( J_{PC} = 5.3 \) Hz); \( ^19F \) NMR (376 MHz, CDCl3) \( \delta \): -112.2; \( ^31P \) NMR (162 MHz, CDCl3) \( \delta \): -1.3. HRMS Calculated for C13H25FNO4PS [M+H]+ 383.0436, found 383.0841.

Diisopropyl (6-chloro-2,2-dioxidobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (1h): The reaction was conducted by using 7h (0.840 g, 2.2 mmol), affording 0.164 g (20% yield) of 1h as a white solid, m.p. = 62-63 °C, Rf = 0.40 (dichloromethane). \( ^1H \) NMR (400 MHz, CDCl3) \( \delta \): 8.50 (s, \( J_{PC} = 8.9 \) Hz, \( J_{PC} = 2.7 \) Hz), 120.6 (d, \( J_{PC} = 8.4 \) Hz), 118.3 (dd, \( J_{PC} = 8.2 \) Hz, \( J_{PC} = 3.7 \) Hz), 116.9 (dd, \( J_{PC} = 23.9 \) Hz, \( J_{PC} = 1.8 \) Hz), 114.6 (dd, \( J_{PC} = 26.5 \) Hz, \( J_{PC} = 3.0 \) Hz), 74.1 (d, \( J_{PC} = 7.1 \) Hz), 73.9 (d, \( J_{PC} = 7.0 \) Hz), 54.3 (d, \( J_{PC} = 155.7 \) Hz), 24.2 (d, \( J_{PC} = 3.4 \) Hz), 24.1 (d, \( J_{PC} = 4.0 \) Hz), 23.9 (d, \( J_{PC} = 4.9 \) Hz), 23.7 (d, \( J_{PC} = 5.3 \) Hz); \( ^19F \) NMR (376 MHz, CDCl3) \( \delta \): -115.2; \( ^31P \) NMR (162 MHz, CDCl3) \( \delta \): 13.9. HRMS Calculated for C13H25FNO4PS [M+H]+ 386.0727, found 386.0727.
**Diisopropyl (6-bromo-2,2-dioxidobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (1i):** The reaction was conducted by using 7i (0.922 g, 2.2 mmol), affording 0.300 g (32% yield) of 1i as a white solid, m.p. = 48-49 °C, Rf = 0.40 (dichloromethane). 1H NMR (400 MHz, CDCl3) δ 8.71-8.61 (m, 1H), 7.91-7.77 (m, 1H), 7.20 (d, J = 8.8 Hz, 1H), 5.10-4.85 (m, 2H), 1.51-1.39 (m, 12H); 13C NMR (100 MHz, CDCl3) δ 172.7 (d, JPC = 201.2 Hz), 153.3 (d, JPC = 8.4 Hz), 140.4, 133.8, 120.9 (d, JPC = 3.1 Hz), 119.2, 117.1 (d, JPC = 24.1 Hz), 75.5 (d, JPC = 7.2 Hz), 24.2 (d, JPC = 3.8 Hz), 23.9 (d, JPC = 5.4 Hz); 31P NMR (162 MHz, CDCl3) δ -1.3. HRMS Calculated for C13H21BrN2O6PS [M+NH4]+ 443.0036, found 443.0035.

**3. Pd-Catalyzed Asymmetric Arylation of Cyclic α-Ketiminophosphonates**

[Diagram showing the reaction of Pd(OCOCF3)2 with 1 and 3 to form 4.]

Pd(OCOCF3)2 (0.7 mg, 0.002 mmol) and (S)-Bu-Phox (1.2 mg, 0.003 mmol) were placed in a dried Schlenk tube, and degassed anhydrous acetone (1 mL) was added. The mixture was stirred at room temperature for 0.5 h, then, the solvent was removed under vacuum to give the catalyst. In air, to the mixture of iminophosphonates (1 or 3, 0.20 mmol) and arylboronic acids (0.40 mmol) was added the above catalyst with 2,2,2-trifluoroethanol (4.0 mL). The solution was stirred at 70 °C for 12-48 h. The reaction mixture was cooled to room temperature, and the solvent was removed by rotary evaporation. Flash chromatography on silica gel using dichloromethane as the eluent gave the quaternary α-aminophosphonates products.

**(S)-(+)-Diisopropyl(2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2a):** 81 mg, 95% yield, 99.9% ee, [α]D20 +70.84 (c 1.66, CHCl3), unknown compound, white solid, m.p. = 184-185 °C, Rf = 0.30 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.87-7.66 (m, 3H), 7.48-7.18 (m, 6H), 7.12 (d, J = 8.0 Hz, 1H), 4.80-4.60 (m, 1H), 4.60-4.40 (m, 1H), 1.27 (d, J = 5.9 Hz, 3H), 1.22 (d, J = 5.9 Hz, 3H), 1.15 (d, J = 5.9 Hz, 3H), 0.86 (d, J = 5.8 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 151.2 (d, JPC = 8.3 Hz), 137.4 (d, JPC = 0.9 Hz), 130.7 (d, JPC = 3.4 Hz), 130.3 (d, JPC = 1.8 Hz), 128.7 (d, JPC = 2.1 Hz), 128.5 (d, JPC = 5.5 Hz), 128.3 (d, JPC = 1.5 Hz), 124.8 (d, JPC = 2.2 Hz), 120.6 (d, JPC = 6.0 Hz), 119.9, 74.8 (d, JPC = 7.7 Hz), 74.1 (d, JPC = 7.8 Hz), 67.5 (d, JPC = 155.5 Hz), 24.5 (d, JPC = 2.3 Hz), 24.2 (d, JPC = 3.1 Hz), 23.5 (d, JPC = 5.8 Hz), 22.9 (d, JPC = 6.5 Hz); 31P NMR (162 MHz, CDCl3) δ 15.1. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 80/20, flow = 0.7 mL/min, retention time 18.7 min.
and 22.5 min (maj). HRMS Calculated for C_{19}H_{25}NO_{6}PS [M+H]^+ 426.1135, found 426.1137.

(S)-(+) -Diethyl(2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2b): 77 mg, 97% yield, 99.8% ee, [α]_{D}^{20} = +62.09 (c 1.72, CHCl₃), unknown compound, white solid, m.p. = 168-169 °C, R_{p} = 0.50 (dichloromethane/methanol 80/1). \(^{1}H\) NMR (400 MHz, CDCl₃) \(δ\) 7.81 (d, \(J = 8.0\) Hz, 1H), 7.75-7.65 (m, 2H), 7.43 (t, \(J = 7.8\) Hz, 1H), 7.40-7.32 (m, 3H), 7.32-7.27 (m, 1H), 7.15 (d, \(J = 8.2\) Hz, 1H), 6.53 (s, 1H), 4.13-3.96 (m, 3H), 3.87-3.75 (m, 1H), 1.22 (t, \(J = 7.1\) Hz, 3H), 1.13 (t, \(J = 7.1\) Hz, 3H); \(^{13}C\) NMR (100 MHz, CDCl₃) \(δ\) 151.2 (d, \(J_{PC} = 8.3\) Hz), 136.7 (d, \(J_{PC} = 1.8\) Hz), 130.6 (d, \(J_{PC} = 3.5\) Hz), 130.5 (d, \(J_{PC} = 2.1\) Hz), 128.9 (d, \(J_{PC} = 2.1\) Hz), 128.6 (d, \(J_{PC} = 5.7\) Hz), 128.5 (d, \(J_{PC} = 2.1\) Hz), 125.2 (d, \(J_{PC} = 2.3\) Hz), 121.2 (d, \(J_{PC} = 4.9\) Hz), 120.0 (d, \(J_{PC} = 0.8\) Hz), 67.5 (d, \(J_{PC} = 154.2\) Hz), 65.2 (d, \(J_{PC} = 6.8\) Hz), 65.1 (d, \(J_{PC} = 6.8\) Hz), 16.4 (d, \(J_{PC} = 5.7\) Hz), 16.3 (d, \(J_{PC} = 5.4\) Hz); \(^{31}P\) NMR (162 MHz, CDCl₃) \(δ\) 16.7. HPLC: Chiracel AS-H column, 220 nm, 30 °C, n-hexane/i-propanol = 70/30, flow = 0.7 mL/min, retention time 9.8 min (maj) and 18.1 min. HRMS Calculated for C_{19}H_{25}NO_{6}PS [M+H]^+ 398.0822, found 398.0824.

(S)-(+) -Diisopropyl(7-methyl-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2c): 78 mg, 89% yield, 99.9% ee, [α]_{D}^{20} = +57.59 (c 1.62, CHCl₃), unknown compound, white solid, m.p. = 173-174 °C, R_{p} = 0.50 (dichloromethane/methanol 80/1). \(^{1}H\) NMR (400 MHz, CDCl₃) \(δ\) 7.74 (d, \(J = 7.0\) Hz, 2H), 7.67 (d, \(J = 7.5\) Hz, 1H), 7.40-7.28 (m, 3H), 7.08 (d, \(J = 8.0\) Hz, 1H), 6.94 (s, 1H), 6.72 (s, 1H), 4.70-4.57 (m, 1H), 4.56-4.44 (m, 1H), 2.93 (s, 3H), 1.27 (d, \(J = 6.1\) Hz, 3H), 1.23 (d, \(J = 6.1\) Hz, 3H), 1.15 (d, \(J = 6.1\) Hz, 3H), 0.89 (d, \(J = 6.1\) Hz, 3H); \(^{13}C\) NMR (100 MHz, CDCl₃) \(δ\) 151.1 (d, \(J_{PC} = 8.3\) Hz), 141.0 (d, \(J_{PC} = 2.3\) Hz), 137.4 (d, \(J_{PC} = 1.2\) Hz), 130.4 (d, \(J_{PC} = 3.5\) Hz), 128.7 (d, \(J_{PC} = 2.1\) Hz), 128.6 (d, \(J_{PC} = 5.5\) Hz), 128.3 (d, \(J_{PC} = 1.7\) Hz), 125.9 (d, \(J_{PC} = 2.3\) Hz), 120.1 (d, \(J_{PC} = 0.8\) Hz), 117.6 (d, \(J_{PC} = 5.7\) Hz), 74.5 (d, \(J_{PC} = 7.8\) Hz), 74.1 (d, \(J_{PC} = 7.8\) Hz), 67.3 (d, \(J_{PC} = 155.3\) Hz), 24.5 (d, \(J_{PC} = 2.4\) Hz), 24.3 (d, \(J_{PC} = 3.0\) Hz), 23.5 (d, \(J_{PC} = 6.0\) Hz), 23.1 (d, \(J_{PC} = 6.3\) Hz), 21.2; \(^{31}P\) NMR (162 MHz, CDCl₃) \(δ\) 15.3. HPLC: Chiracel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 80/20, flow = 0.7 mL/min, retention time 14.1 min and 25.1 min (maj). HRMS Calculated for C_{20}H_{27}NO_{6}PS [M+H]^+ 440.1291, found 440.1295.

(S)-(+) -Diisopropyl(8-methoxy-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2d): 81 mg, 89% yield, 99.9% ee, [α]_{D}^{20} = +77.53 (c 1.50, CHCl₃), unknown compound, white solid, m.p. = 206-207 °C, R_{p} = 0.50 (dichloromethane/methanol 80/1). \(^{1}H\) NMR (400 MHz, CDCl₃) \(δ\) 7.76-7.70 (m, 2H), 7.45-7.39 (m, 1H), 7.39-7.30 (m, 3H), 7.20 (t, \(J = 8.2\) Hz, 1H), 7.00 (d, \(J = 8.3\) Hz, 1H), 6.58 (brs, 1H), 4.71-4.58 (m, 1H), 4.57-4.45 (m, 1H), 3.90 (s, 3H), 1.28 (d, \(J = 6.2\) Hz, 3H), 1.24 (d, \(J = 6.2\) Hz, 3H); \(^{13}C\) NMR (100 MHz, CDCl₃) \(δ\) 149.80, 141.1 (d, \(J_{PC} = 8.9\) Hz), 137.2 (d, \(J_{PC} = 1.9\) Hz), 128.7 (d, \(J_{PC} = 2.3\) Hz), 128.6 (d, \(J_{PC} = 5.5\) Hz), 128.3 (d, \(J_{PC} = 1.8\) Hz), 124.5 (d, \(J_{PC} = 2.2\) Hz), 122.2 (d, \(J_{PC} = 5.2\) Hz), 121.7 (d, \(J_{PC} = 3.4\) Hz), 112.8 (d, \(J_{PC} = 2.1\) Hz), 74.7 (d, \(J_{PC} = 7.7\) Hz), 74.1 (d, \(J_{PC} = 7.9\) Hz), 67.8 (d, \(J_{PC} = 155.2\) Hz), 56.6, 24.5 (d, \(J_{PC} = 2.4\) Hz), 24.2 (d, \(J_{PC} = 3.3\) Hz), 23.6 (d, \(J_{PC} = 5.8\) Hz), 23.0 (d, \(J_{PC} = 6.4\) Hz); \(^{31}P\) NMR (162 MHz, CDCl₃) \(δ\) 15.1. HPLC: Chiracel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 70/30, flow = 0.7 mL/min, retention time 20.0 min and 36.6 min (maj). HRMS Calculated for C_{20}H_{27}NO_{6}PS [M+H]^+ 456.1240, found 456.1239.
(S)-(+-)Disopropyl(7-methoxy-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2f): 83 mg, 91% yield, 99.9% ee, [α]20 D = +46.89 (c 1.74, CHCl3), unknown compound, white solid, m.p. = 162-163 °C, Rf = 0.50 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.74 (d, J = 6.6 Hz, 2H), 7.69 (d, J = 8.8 Hz, 1H), 7.39-7.28 (m, 3H), 6.88-6.79 (m, 1H), 6.77 (s, 1H), 6.65 (s, 1H), 4.71-4.57 (m, 1H), 4.57-4.42 (m, 1H), 3.84 (s, 3H), 1.27 (d, J = 6.1 Hz, 3H), 1.24 (d, J = 6.1 Hz, 3H), 1.17 (d, J = 6.1 Hz, 3H), 0.90 (d, J = 6.1 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 160.9 (d, JPC = 1.8 Hz), 152.1 (d, JPC = 8.2 Hz), 137.6, 131.4 (d, JPC = 3.3 Hz), 128.7 (d, JPC = 2.1 Hz), 128.5 (d, JPC = 5.5 Hz), 128.3 (d, JPC = 1.7 Hz), 112.1 (d, JPC = 6.0 Hz), 111.7 (d, JPC = 2.2 Hz), 104.5, 74.6 (d, JPC = 7.8 Hz), 74.1 (d, JPC = 7.8 Hz), 67.0 (d, JPC = 155.7 Hz), 55.9, 24.5 (d, JPC = 2.4 Hz), 24.3 (d, JPC = 3.1 Hz), 23.6 (d, JPC = 5.9 Hz), 23.1 (d, JPC = 6.3 Hz); 31P NMR (162 MHz, CDCl3) δ 15.4. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 70/30, flow = 0.7 mL/min, retention time 12.7 min and 25.5 min (maj). HRMS Calculated for C20H27NO7PS [M+H]+ 456.1240, found 456.1244.

(S)+(--)Disopropyl(6-fluoro-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2g): 82 mg, 92% yield, 99.9% ee, [α]20 D = +71.56 (c 1.60, CHCl3), unknown compound, white solid, m.p. = 142-143 °C, Rf = 0.60 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.75 (d, J = 3.3 Hz, 2H), 7.47 (d, J = 9.4 Hz, 1H), 7.42-7.32 (m, 3H), 7.20-7.05 (m, 2H), 4.82-4.65 (m, 1H), 4.64-4.46 (m, 1H), 1.28 (d, J = 6.2 Hz, 3H), 1.22 (d, J = 6.1 Hz, 3H), 1.17 (d, J = 6.2 Hz, 3H), 0.91 (d, J = 6.2 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 158.7 (dd, JPC = 244.6 Hz, JPC = 2.8 Hz), 147.2 (dd, JPC = 8.0 Hz, JPC = 2.6 Hz), 137.2, 128.9 (d, JPC = 1.9 Hz), 128.5 (d, JPC = 1.5 Hz), 128.4 (d, JPC = 5.7 Hz), 122.6, 121.1 (d, JPC = 8.8 Hz), 117.3 (d, JPC = 29.5 Hz), 117.3 (d, JPC = 22.8 Hz), 75.1 (d, JPC = 7.8 Hz), 74.4 (d, JPC = 7.8 Hz), 67.5 (d, JPC = 156.6 Hz), 24.3 (d, JPC = 2.5 Hz), 24.2 (d, JPC = 3.2 Hz), 23.5 (d, JPC = 5.8 Hz), 23.0 (d, JPC = 6.3 Hz); 31F NMR (376 MHz, CDCl3) δ -115.8; 31P NMR (162 MHz, CDCl3) δ 14.4. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 80/20, flow = 0.7 mL/min, retention time 19.4 min and 24.2 min (maj). HRMS Calculated for C19H24FNO6PS [M+H]+ 444.1040, found 444.1045.
(S)-(+) Diisopropyl(6-chloro-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2h): 82 mg, 89% yield, 99.9% ee, [α]20D = +65.79 (c 1.64, CHCl3), unknown compound, white solid, m.p. = 190-191 °C, Rf = 0.40 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.84-7.64 (m, 3H), 7.45-7.29 (m, 5H), 7.08 (d, J = 8.7 Hz, 1H), 4.78-4.64 (m, 1H), 4.62-4.47 (m, 1H), 1.29 (d, J = 6.1 Hz, 3H), 1.22 (d, J = 6.1 Hz, 3H), 1.18 (d, J = 6.2 Hz, 3H), 0.94 (d, J = 6.2 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 149.8 (d, JPC = 8.2 Hz), 136.9, 130.4 (d, JPC = 3.4 Hz), 130.3 (d, JPC = 2.1 Hz), 130.2 (d, JPC = 2.7 Hz), 129.0 (d, JPC = 2.0 Hz), 128.5 (d, JPC = 1.5 Hz), 128.4 (d, JPC = 5.5 Hz), 122.6 (d, JPC = 6.2 Hz), 121.1, 75.0 (d, JPC = 7.8 Hz), 74.4 (d, JPC = 7.8 Hz), 67.4 (d, JPC = 155.8 Hz), 24.3 (d, JPC = 2.7 Hz), 24.2 (d, JPC = 3.2 Hz), 23.5 (d, JPC = 5.8 Hz), 23.1 (d, JPC = 6.1 Hz); 31P NMR (162 MHz, CDCl3) δ 14.4. HPLC: Chiralcel AS-H column, 220 nm, 30 °C, n-hexane/i-propanol = 95/5, flow = 0.7 mL/min, retention time 17.2 min (maj) and 22.6 min. HRMS Calculated for C19H24BrNO6PS [M+H]+ 504.0240, found 504.0244.

(S)-(+) Diisopropyl(6-bromo-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2i): 74 mg, 73% yield, 99.9% ee, [α]20D = +65.00 (c 1.48, CHCl3), unknown compound, white solid, m.p. = 192-193 °C, Rf = 0.30 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.91 (s, 1H), 7.71 (d, J = 5.0 Hz, 2H), 7.53 (d, J = 8.6 Hz, 1H), 7.45-7.32 (m, 3H), 7.02 (d, J = 8.7 Hz, 1H), 4.78-4.63 (m, 1H), 4.62-4.46 (m, 1H), 1.29 (d, J = 6.1 Hz, 3H), 1.22 (d, J = 6.1 Hz, 3H), 1.18 (d, J = 6.1 Hz, 3H), 0.95 (d, J = 6.1 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 150.4 (d, JPC = 7.9 Hz), 136.8 (d, JPC = 1.4 Hz), 133.3 (d, JPC = 3.3 Hz), 133.2 (d, JPC = 2.0 Hz), 129.0 (d, JPC = 1.9 Hz), 128.6 (d, JPC = 1.4 Hz), 128.5 (d, JPC = 5.5 Hz), 123.0 (d, JPC = 6.2 Hz), 121.5, 117.6 (d, JPC = 2.9 Hz), 75.0 (d, JPC = 8.0 Hz), 74.5 (d, JPC = 7.8 Hz), 67.3 (δPC = 155.6 Hz), 24.3 (d, JPC = 2.8 Hz), 24.2 (d, JPC = 3.2 Hz), 23.6 (d, JPC = 5.8 Hz), 23.1 (d, JPC = 6.1 Hz); 31P NMR (162 MHz, CDCl3) δ 14.4. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 80/20, flow = 0.7 mL/min, retention time 21.1 min (maj) and 25.3 min. HRMS Calculated for C20H27NO6PS [M+H]+ 504.0240, found 504.0244.

(S)-(+) Diisopropyl(2,2-dioxido-4-(p-tolyl)-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2j): 78 mg, 89% yield, 99.0% ee, [α]20D = +59.77 (c 1.74, CHCl3), unknown compound, white solid, m.p. = 150-151 °C, Rf = 0.60 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.81 (d, J = 8.0 Hz, 1H), 7.60 (d, J = 6.8 Hz, 2H), 7.41 (t, J = 7.8 Hz, 1H), 7.30-7.22 (m, 1H), 7.18-7.09 (m, 3H), 6.57 (s, 1H), 4.68-4.58 (m, 1H), 4.56-4.46 (m, 1H), 2.33 (s, 3H), 1.27 (d, J = 6.2 Hz, 3H), 1.23 (d, J = 6.1 Hz, 3H), 1.17 (d, J = 6.2 Hz, 3H), 0.89 (d, J = 6.2 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 151.3 (d, JPC = 8.3 Hz), 138.6 (d, JPC = 2.4 Hz), 134.2 (d, JPC = 1.6 Hz), 130.7 (d, JPC = 3.5 Hz), 130.3 (d, JPC = 2.0 Hz), 129.1 (d, JPC = 1.7 Hz), 128.5 (d, JPC = 5.6 Hz), 125.0 (d, JPC = 2.3 Hz), 121.0 (d, JPC = 5.6 Hz), 119.9 (d, JPC = 0.8 Hz), 74.5 (d, JPC = 7.7 Hz), 74.1 (d, JPC = 7.8 Hz), 67.4 (d, JPC = 155.2 Hz), 24.5 (d, JPC = 2.5 Hz), 24.3 (d, JPC = 3.0 Hz), 23.6 (d, JPC = 6.0 Hz), 23.0 (d, JPC = 6.3 Hz), 21.3; 31P NMR (162 MHz, CDCl3) δ 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 60/40, flow = 0.6 mL/min, retention time 14.2 min and 44.4 min (maj). HRMS Calculated for C20H27NO6PS [M+H]+ 440.1291, found 440.1291.
(S)-(+) Disisopropyl(4-(4-methoxyphenyl)-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2k): 82 mg, 90% yield, 99.9% ee, [α]^{20}_{D} = +63.08 (c 1.62, CHCl₃), unknown compound, white solid, m.p. = 172-173 °C, Rₚ = 0.50 (dichloromethane/methanol 80/1). ¹H NMR (400 MHz, CDCl₃) δ 7.80 (d, J = 7.5 Hz, 1H), 7.64 (d, J = 7.9 Hz, 2H), 7.41 (t, J = 7.3 Hz, 1H), 7.30-7.22 (m, 1H), 7.12 (d, J = 7.9 Hz, 1H), 6.86 (d, J = 8.4 Hz, 2H), 6.74 (brs, 1H), 4.75-4.60 (m, 1H), 4.60-4.40 (m, 1H), 3.80 (s, 3H), 1.27 (d, J = 5.9 Hz, 3H), 1.24 (d, J = 5.9 Hz, 3H), 1.18 (d, J = 5.9 Hz, 3H), 0.89 (d, J = 5.9 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 159.8 (d, J = 19 Hz), 151.3 (d, J = 8.3 Hz), 130.6 (d, J = 3.4 Hz), 130.3 (d, J = 1.9 Hz), 129.9 (d, J = 5.6 Hz), 129.2 (d, J = 1.6 Hz), 124.9 (d, J = 2.2 Hz), 121.0 (d, J = 5.5 Hz), 119.9, 113.7 (d, J = 1.4 Hz), 74.6 (d, J = 7.8 Hz), 74.0 (d, J = 7.9 Hz), 67.2 (d, J = 156.4 Hz), 55.4, 24.5 (d, J = 2.3 Hz), 24.3 (d, J = 3.2 Hz), 23.6 (d, J = 5.8 Hz), 23.1 (d, J = 6.3 Hz); ³¹P NMR (162 MHz, CDCl₃) δ 31.2. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 60/40, flow = 0.6 mL/min, retention time 17.1 min and 53.3 min (maj). HRMS Calculated for C₂₀H₂₇NO₇PS [M+H]^+ 456.1240, found 456.1242.

(S)-(+) Disisopropyl(2,2-dioxido-4-(m-tolyl)-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2I): 71 mg, 81% yield, 99.9% ee, [α]^{20}_{D} = +70.56 (c 1.42, CHCl₃), unknown compound, white solid, m.p. = 180-181 °C, Rₚ = 0.50 (dichloromethane/methanol 80/1). ¹H NMR (400 MHz, CDCl₃) δ 7.86-7.80 (m, 1H), 7.56-7.49 (m, 2H), 7.46-7.37 (m, 1H), 7.31-7.19 (m, 2H), 7.13 (t, J = 7.2 Hz, 2H), 6.82 (brs, 1H), 4.74-4.59 (m, 1H), 4.57-4.42 (m, 1H), 2.33 (s, 3H), 1.28 (d, J = 6.2 Hz, 3H), 1.23 (d, J = 6.2 Hz, 3H), 1.16 (d, J = 6.2 Hz, 3H), 1.06 (d, J = 6.2 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 151.3 (d, J = 8.4 Hz), 137.9 (d, J = 1.8 Hz), 137.0 (d, J = 1.8 Hz), 130.7 (d, J = 3.5 Hz), 130.2 (d, J = 2.0 Hz), 129.5 (d, J = 2.2 Hz), 129.1 (d, J = 5.5 Hz), 128.2 (d, J = 1.7 Hz), 125.7 (d, J = 5.4 Hz), 124.8 (d, J = 2.2 Hz), 120.8 (d, J = 5.8 Hz), 119.9, 74.7 (d, J = 7.8 Hz), 74.0 (d, J = 7.9 Hz), 67.5 (d, J = 154.7 Hz), 24.5 (d, J = 2.2 Hz), 24.2 (d, J = 3.2 Hz), 23.6 (d, J = 5.9 Hz), 22.9 (d, J = 6.5 Hz), 21.8; ³¹P NMR (162 MHz, CDCl₃) δ 15.2. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 60/40, flow = 0.6 mL/min, retention time 10.5 min (maj) and 13.9 min. HRMS Calculated for C₂₀H₁₇NO₆PS [M+H]^+ 440.1291, found 440.1295.

(S)-(+) Disisopropyl(4-(3-methoxyphenyl)-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2m): 84 mg, 92% yield, 99.9% ee, [α]^{20}_{D} = +61.01 (c 1.68, CHCl₃), unknown compound, white solid, m.p. = 129-130 °C, Rₚ = 0.40 (dichloromethane/methanol 80/1). ¹H NMR (400 MHz, CDCl₃) δ 7.85 (d, J = 8.0 Hz, 1H), 7.34-7.29 (m, 1H), 7.29-7.23 (m, 2H), 7.27 (d, J = 6.6 Hz, 2H), 7.13 (d, J = 8.2 Hz, 1H), 6.87 (d, J = 7.9 Hz, 1H), 6.26 (brs, 1H), 4.70-4.58 (m, 1H), 4.56-4.43 (m, 1H), 3.77 (s, 3H), 1.28 (d, J = 6.2 Hz, 3H), 1.25 (d, J = 6.2 Hz, 3H), 1.17 (d, J = 6.2 Hz, 3H), 0.88 (d, J = 6.2 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 159.5 (d, J = 1.3 Hz), 151.2 (d, J = 8.2 Hz), 138.9 (d, J = 0.8 Hz), 130.6 (d, J = 3.5 Hz), 130.3 (d, J = 1.9 Hz), 129.3 (d, J = 1.7 Hz), 124.9 (d, J = 2.1 Hz), 120.9 (d, J = 5.2 Hz), 120.6 (d, J = 5.9 Hz), 119.8, 114.8 (d, J = 5.8 Hz), 113.9 (d, J = 1.9 Hz), 74.8 (d, J = 7.7 Hz), 74.1 (d, J = 7.9 Hz), 67.5 (d, J = 155.0 Hz), 55.4, 24.5 (d, J = 2.3 Hz), 24.2 (d, J = 3.2 Hz), 23.6 (d, J = 5.7 Hz), 23.0 (d, J = 6.5 Hz); ³¹P NMR (162 MHz, CDCl₃) δ 15.1. HPLC: Chiralcel AD-H column, 220 nm, 30 °C,
(S)-(+) -Diisopropyl(4-(3,5-dimethylphenyl)-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2n): 82 mg, 90% yield, 99.6% ee, [α]20D = +70.42 (c 1.64, CHCl3), unknown compound, white solid, m.p. = 200-201 °C, Rf = 0.60 (dichloromethane/methanol 80/1).

1H NMR (400 MHz, CDCl3) δ 7.85 (d, J = 8.0 Hz, 1H), 7.41 (t, J = 7.8 Hz, 1H), 7.32-7.23 (m, 3H), 7.11 (d, J = 8.2 Hz, 1H), 6.94 (s, 1H), 4.70-4.56 (m, 1H), 4.55-4.41 (m, 1H), 2.27 (s, 6H), 1.27 (d, J = 6.2 Hz, 3H), 1.23 (d, J = 6.2 Hz, 3H), 1.17 (d, J = 6.2 Hz, 3H), 0.85 (d, J = 6.2 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 151.2 (d, δPC = 5.5 Hz), 137.7 (d, δPC = 1.8 Hz), 136.7 (d, δPC = 2.0 Hz), 130.7 (d, δPC = 3.5 Hz), 130.5 (d, δPC = 2.2 Hz), 126.3 (d, δPC = 5.5 Hz), 124.8 (d, δPC = 2.2 Hz), 120.9 (d, δPC = 5.2 Hz), 119.8, 74.6 (d, δPC = 7.7 Hz), 73.9 (d, δPC = 7.9 Hz), 67.5 (d, δPC = 154.3 Hz), 24.5 (d, δPC = 2.1 Hz), 24.2 (d, δPC = 3.1 Hz), 23.5 (d, δPC = 6.0 Hz), 22.9 (d, δPC = 6.5 Hz), 21.7; 31P NMR (162 MHz, CDCl3) δ 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 60/40, flow = 0.6 mL/min, retention time 7.2 min (maj) and 12.9 min. HRMS Calculated for C21H28NO6PS [M+H]+ 454.1448, found 454.1450.

(S)-(+) -Diisopropyl(4-(4-fluorophenyl)-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2o): 85 mg, 96% yield, 99.9% ee, [α]20D = +63.48 (c 1.78, CHCl3), unknown compound, white solid, m.p. = 186-187 °C, Rf = 0.50 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.86 (d, J = 7.8 Hz, 1H), 7.77-7.66 (m, 2H), 7.44 (t, J = 7.6 Hz, 1H), 7.30 (d, J = 7.7 Hz, 1H), 7.15 (d, J = 8.2 Hz, 1H), 7.03 (t, J = 8.4 Hz, 2H), 6.14 (brs, 1H), 4.71-4.57 (m, 1H), 4.55-4.42 (m, 1H), 1.36-1.22 (m, 6H), 1.19 (d, J = 6.1 Hz, 3H), 0.89 (d, J = 6.1 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 151.3 (d, δPC = 2.2 Hz), 151.2 (d, δPC = 2.2 Hz), 151.3 (d, δPC = 2.3 Hz), 133.3, 130.7, 130.6 (d, δPC = 2.7 Hz), 130.5 (d, δPC = 3.6 Hz), 125.0, 120.5 (d, δPC = 5.9 Hz), 120.0, 115.2 (d, δPC = 22.8 Hz), 74.9 (d, δPC = 7.8 Hz), 74.2 (d, δPC = 7.9 Hz), 67.0 (d, δPC = 156.0 Hz), 24.4 (d, δPC = 2.4 Hz), 24.2 (d, δPC = 2.5 Hz), 23.6 (d, δPC = 5.7 Hz), 23.1 (d, δPC = 6.3 Hz); 31P NMR (376 MHz, CDCl3) δ -113.3 (d, δPC = 3.4 Hz); 31P NMR (162 MHz, CDCl3) δ 14.8. HPLC: Chiralcel OJ-H column, 220 nm, 30 °C, n-hexane/i-propanol = 95/5, flow = 0.6 mL/min, retention time 13.1 min and 17.5 min (maj). HRMS Calculated for C19H24FNO6PS [M+H]+ 444.1040, found 444.1040.

(S)-(+) -Diisopropyl(4-(4-chlorophenyl)-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2p): 79 mg, 86% yield, 99.9% ee, [α]20D = +50.63 (c 1.58, CHCl3), unknown compound, white solid, m.p. = 186-187 °C, Rf = 0.50 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.81-7.73 (m, 1H), 7.71-7.63 (m, 2H), 7.47-7.38 (m, 1H), 7.35-7.27 (m, 3H), 7.13 (d, J = 8.2 Hz, 1H), 4.79-4.60 (m, 1H), 4.60-4.40 (m, 1H), 1.28 (d, J = 6.2 Hz, 3H), 1.23 (d, J = 6.2 Hz, 3H), 1.18 (d, J = 6.2 Hz, 3H), 0.91 (d, J = 6.2 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 151.3 (d, δPC = 8.2 Hz), 136.1 (d, δPC = 1.6 Hz), 134.9 (d, δPC = 2.6 Hz), 130.6 (d, δPC = 2.0 Hz), 130.5 (d, δPC = 3.5 Hz), 130.0 (d, δPC = 5.5 Hz), 128.5 (d, δPC = 1.7 Hz), 125.0 (d, δPC = 2.2 Hz), 120.2 (d, δPC = 5.9 Hz), 120.0, 75.0 (d, δPC = 7.9 Hz), 74.3 (d, δPC = 7.9 Hz), 67.0 (d, δPC = 155.3 Hz), 24.4 (d, δPC = 2.5 Hz), 24.2 (d, δPC = 3.3 Hz), 23.6 (d, δPC = 5.7 Hz), 23.1 (d, δPC = 6.3 Hz); n-hexane/i-propanol = 60/40, flow = 0.6 mL/min, retention time 13.7 min (maj) and 20.7 min. HRMS Calculated for C29H27NO6PS [M+H]+ 456.1240, found 456.1244.
(S)-(+) -Diisopropyl(4-(4-bromophenyl)-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2q): 92 mg, 91% yield, 99.9% ee, [α]D20 = +46.03 (c 1.84, CHCl3), unknown compound, white solid, m.p. = 192-193 °C, Rf = 0.70 (dichloromethane/methanol 80/1).

\[ \text{PC} = \text{156.2 Hz}, \text{PC} = \text{2.7 Hz}, \text{PC} = \text{8.1 Hz}, \text{PC} = \text{3.1 Hz}, \text{PC} = \text{5.9 Hz}, \text{PC} = \text{6.5 Hz} \] 31P NMR (162 MHz, CDCl3) δ 14.6. HPLC: Chiralcel IC-H column, 220 nm, 30 °C, n-hexane/i-propanol = 90/10, flow = 0.7 mL/min, retention time 16.6 min and 22.2 min (maj). HRMS Calculated for C19H23CINO4PS [M+H]+ 460.0745, found 460.0742.

(S)-(+) -Diisopropyl(4-(1,1'-biphenyl)-4-yl)-2,2-dioxido-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (2r): 92 mg, 91% yield, 99.9% ee, [α]D20 = +46.03 (c 1.84, CHCl3), unknown compound, white solid, m.p. = 181-182 °C, Rf = 0.30 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.84-7.62 (m, 3H), 7.42 (t, J = 7.7 Hz, 1H), 7.31-7.24 (m, 2H), 7.13 (d, J = 8.2 Hz, 1H), 7.03 (t, J = 8.5 Hz, 2H), 4.78-4.64 (m, 1H), 4.58-4.44 (m, 1H), 1.28 (d, J = 6.1 Hz, 3H), 1.22 (d, J = 6.1 Hz, 3H), 1.17 (d, J = 6.1 Hz, 3H), 0.90 (d, J = 6.1 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 151.2 (d, JPC = 8.2 Hz), 136.8 (d, JPC = 1.1 Hz), 131.5 (d, JPC = 1.6 Hz), 130.5 (d, JPC = 2.0 Hz), 130.5 (d, JPC = 3.4 Hz), 130.3 (d, JPC = 5.5 Hz), 125.0 (d, JPC = 2.2 Hz), 123.1 (d, JPC = 2.7 Hz), 120.1 (d, JPC = 6.0 Hz), 120.0, 75.0 (d, JPC = 7.8 Hz), 74.3 (d, JPC = 7.9 Hz), 67.1 (d, JPC = 155.8 Hz), 24.4 (d, JPC = 2.5 Hz), 24.2 (d, JPC = 3.3 Hz), 23.6 (d, JPC = 5.8 Hz), 23.1 (d, JPC = 6.3 Hz); 31P NMR (162 MHz, CDCl3) δ 14.5. HPLC: Chiralcel IA-H column, 230 nm, 30 °C, n-hexane/i-propanol = 70/30, flow = 0.7 mL/min, retention time 12.0 min and 19.2 min (maj). HRMS Calculated for C19H23BrNO4PS [M+H]+ 504.0240, found 504.0246.

(S)-(--) -Diisopropyl(1,1-dioxido-3-phenyl-2,3-dihydrobenzo[d]isothiazol-3-yl)phosphonate (4a): 80 mg, 98% yield, 99.0% ee, [α]D20 = -12.62 (c 1.60, CHCl3), unknown compound, white solid, m.p. = 181-182 °C, Rf = 0.30 (dichloromethane/methanol 80/1).

\[ \text{PC} = \text{9.8 Hz}, \text{PC} = \text{7.5 Hz}, \text{PC} = \text{8.5 Hz}, \text{PC} = \text{5.8 Hz}, \text{PC} = \text{159.5 Hz}, \text{PC} = \text{2.6 Hz}, \text{PC} = \text{2.9 Hz}, \text{PC} = \text{6.2 Hz}, \text{PC} = \text{5.8 Hz} \] 31P NMR (162 MHz, CDCl3) δ 15.2. HPLC: Chiralcel AD-H column, 220 nm, 30 °C,
(S)-(−)-Diisopropyl(1,1-dioxido-3-(p-tolyl)-2,3-dihydrobenzo[d]isothiazol-3-yl)phosphonate (4b): 83 mg, 98% yield, 99.4% ee, [α]20°D = -13.19 (c 1.66, CHCl3), unknown compound, colorless oil, Rf = 0.40 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.92 (d, J = 8.0 Hz, 1H), 7.84-7.71 (m, 3H), 7.68-7.59 (m, 1H), 7.55 (t, J = 7.5 Hz, 1H), 7.12 (d, J = 8.2 Hz, 2H), 6.10 (brs, 1H), 4.78-4.59 (m, 1H), 4.54-4.39 (m, 1H), 2.30 (s, 3H), 1.27 (d, J = 6.2 Hz, 6H), 1.01 (d, J = 6.2 Hz, 3H), 0.83 (d, J = 6.2 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 138.4 (d, JPC = 1.7 Hz), 137.6 (d, JPC = 5.1 Hz), 134.8 (d, JPC = 5.7 Hz), 134.4 (d, JPC = 3.0 Hz), 133.1 (d, JPC = 2.1 Hz), 129.9 (d, JPC = 1.9 Hz), 129.5 (d, JPC = 0.9 Hz), 127.1 (d, JPC = 5.4 Hz), 127.0 (d, JPC = 2.9 Hz), 121.5 (d, JPC = 0.9 Hz), 74.0 (d, JPC = 7.6 Hz), 73.7 (d, JPC = 7.5 Hz), 66.9 (d, JPC = 159.9 Hz), 24.5 (d, JPC = 2.7 Hz), 24.4 (d, JPC = 2.8 Hz), 23.4 (d, JPC = 6.2 Hz), 23.0 (d, JPC = 5.8 Hz), 21.2; 31P NMR (162 MHz, CDCl3) δ 15.4. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 70/30, flow = 0.7 mL/min, retention time 19.7 min (maj) and 25.3 min. HRMS Calculated for C20H27NO6PS [M+H]+ 424.1332, found 424.1332.

(S)-(−)-Diisopropyl(3-(4-methoxyphenyl)-1,1-dioxido-2,3-dihydrobenzo[d]isothiazol-3-yl)phosphonate (4c): 85 mg, 97% yield, 98.5% ee, [α]20°D = -4.82 (c 1.70, CHCl3), unknown compound, colorless oil, Rf = 0.50 (dichloromethane/methanol 80/1). 1H NMR (400 MHz, CDCl3) δ 7.90 (d, J = 7.9 Hz, 1H), 7.84-7.72 (m, 3H), 7.69-7.60 (m, 1H), 7.55 (t, J = 7.5 Hz, 1H), 6.83 (d, J = 8.9 Hz, 2H), 6.18 (brs, 1H), 4.78-4.59 (m, 1H), 4.56-4.37 (m, 1H), 3.75 (s, 3H), 1.27 (d, J = 6.1 Hz, 3H), 1.26 (d, J = 6.2 Hz, 3H), 1.02 (d, J = 6.2 Hz, 3H), 0.84 (d, J = 6.2 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 159.7 (d, JPC = 1.4 Hz), 137.6 (d, JPC = 5.0 Hz), 134.9 (d, JPC = 5.7 Hz), 133.1 (d, JPC = 2.1 Hz), 129.9 (d, JPC = 1.9 Hz), 129.4 (d, JPC = 3.0 Hz), 128.7 (d, JPC = 5.4 Hz), 126.9 (d, JPC = 2.8 Hz), 121.5 (d, JPC = 0.6 Hz), 114.1 (d, JPC = 0.5 Hz), 74.1 (d, JPC = 7.6 Hz), 73.7 (d, JPC = 7.6 Hz), 66.7 (d, JPC = 160.9 Hz), 55.4, 24.5 (d, JPC = 2.6 Hz), 24.3 (d, JPC = 2.9 Hz), 23.4 (d, JPC = 6.2 Hz), 23.1 (d, JPC = 5.8 Hz); 31P NMR (162 MHz, CDCl3) δ 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 70/30, flow = 0.7 mL/min, retention time 19.7 min (maj) and 31.2 min. HRMS Calculated for C20H27NO6PS [M+H]+ 424.1342, found 424.1335.

(S)-(−)-Diisopropyl(3-(4-bromophenyl)-1,1-dioxido-2,3-dihydrobenzo[d]isothiazol-3-yl)phosphonate (4d): 93 mg, 95% yield, 99.5% ee, [α]20°D = -14.03 (c 1.86, CHCl3), unknown compound, white solid, m.p. = 169-170 °C, Rf = 0.80 (dichloromethane/methanol 40/1). 1H NMR (400 MHz, CDCl3) δ 7.90 (d, J = 7.9 Hz, 1H), 7.83-7.73 (m, 3H), 7.69-7.62 (m, 1H), 7.58 (t, J = 7.5 Hz, 1H), 7.44 (d, J = 8.6 Hz, 2H), 6.49 (brs, 1H), 4.76-4.63 (m, 1H), 4.56-4.42 (m, 1H), 1.28 (d, J = 6.2 Hz, 6H), 1.03 (d, J = 6.2 Hz, 3H), 0.86 (d, J = 6.2 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 136.6 (d, JPC = 3.1 Hz), 134.9 (d, JPC = 5.7 Hz), 133.3 (d, JPC = 2.0 Hz), 131.9 (d, JPC = 0.9 Hz), 130.2 (d, JPC = 1.8 Hz), 129.1 (d, JPC = 5.2 Hz), 126.8 (d, JPC = 2.8 Hz), 123.0 (d, JPC = 2.2 Hz), 121.6, 74.4 (d, JPC = 7.6 Hz), 74.1 (d, JPC = 7.6 Hz), 66.4 (d, JPC = 159.6 Hz), 24.5 (d, JPC = 2.7 Hz), 24.3 (d, JPC = 3.0 Hz), 23.4 (d, JPC = 6.2 Hz), 23.1 (d, JPC = 5.7 Hz); 31P NMR (162 MHz, CDCl3) δ 14.7. HPLC: Chiralcel AD-H column, 220 nm, 30 °C,
n-hexane/i-propanol = 70/30, flow = 0.7 mL/min, retention time 18.3 min (maj) and 30.2 min.

HRMS Calculated for C_{19}H_{24}BrNO_{5}PS [M+H]^+ 488.0291, found 488.0293.

(S)-(-)-Diisopropyl(6-methyl-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate (4e): 81 mg, 95% yield, 99.4% ee, [α]_{D}^{20} = -7.34 (c 1.54, CHCl_{3}), unknown compound, white solid, m.p. = 173-174 °C, R_{f} = 0.20 (dichloromethane/methanol 80/1). \[^{1}\]H NMR (400 MHz, CDCl_{3}) \(\delta\) 7.95 (d, \(J = 7.6\) Hz, 2H), 7.73 (s, 1H), 7.66 (d, \(J = 8.0\) Hz, 1H), 7.41-7.27 (m, 4H), 5.77 (brs, 1H), 4.83-4.56 (m, 1H), 4.55-4.34 (m, 1H), 2.47 (s, 3H), 1.28 (d, \(J = 6.1\) Hz, 3H), 1.28 (d, \(J = 6.1\) Hz, 3H), 1.00 (d, \(J = 6.2\) Hz, 3H), 0.83 (d, \(J = 6.2\) Hz, 3H); \[^{13}\]C NMR (100 MHz, CDCl_{3}) \(\delta\) 144.3 (d, \(J_{PC} = 1.9\) Hz), 137.8 (d, \(J_{PC} = 4.8\) Hz), 137.7 (d, \(J_{PC} = 3.2\) Hz), 132.2 (d, \(J_{PC} = 5.6\) Hz), 131.1 (d, \(J_{PC} = 2.0\) Hz), 128.8, 128.6 (d, \(J_{PC} = 1.4\) Hz), 127.2 (d, \(J_{PC} = 5.4\) Hz), 127.1 (d, \(J_{PC} = 3.0\) Hz), 121.2, 73.9 (d, \(J_{PC} = 7.0\) Hz), 73.8 (d, \(J_{PC} = 7.3\) Hz), 66.8 (d, \(J_{PC} = 158.4\) Hz), 24.4 (d, \(J_{PC} = 2.7\) Hz), 24.4 (d, \(J_{PC} = 3.0\) Hz), 23.4 (d, \(J_{PC} = 6.0\) Hz), 23.0 (d, \(J_{PC} = 5.8\) Hz), 22.1; \[^{31}\]P NMR (162 MHz, CDCl_{3}) \(\delta\) 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, n-hexane/i-propanol = 70/30, flow = 0.7 mL/min, retention time 14.1 min (maj) and 15.7 min. HRMS Calculated for C_{20}H_{27}NO_{5}PS [M+H]^+ 424.1342, found 424.1345.

4. Determination of the Absolute Configuration of (+)-2a

Based on the single crystal X-ray diffraction analysis, the absolute configuration of product (+)-2a was determined to be (S)-(+)-diisopropyl(2,2-dioxido-4-phenyl-3,4-dihydrobenzo[e][1,2,3]oxathiazin-4-yl)phosphonate 2a. The CCDC number is 1469544. These details can be obtained free of charge via www.ccdc.com. ac.uk/data_request/cif from the Cambridge Crystallographic Data Centre.

![X-ray Single Crystal Structure of (S)-(+)-2a](image)

4. References

5. Copy of NMR and HPLC for the Compounds

\[ \text{1H NMR ZY-4-52A in CDCl3} \]

\[ \text{7g }^{1}\text{H NMR (400 MHz, CDCl3)} \]
$^{13}$C NMR ZY-4-52A in CDCl$_3$

$^{13}$C NMR (100 MHz, CDCl$_3$)
$^1$H NMR 2Y-4-52A in CDCl$_3$
$^{31}$P NMR ZY-4-S2A in CDCl$_3$

$\begin{align*}
\text{F} & \quad \text{O} & \quad \text{SO} \\
\text{O} & \quad \text{S} & \quad \text{O} \\
\text{N} & \quad \text{H} \\
\text{F} & \quad \text{PO(OiPr)$_2$}
\end{align*}$

$7g$ $^{31}$P NMR (162 MHz, CDCl$_3$)

![NMR spectrum](image)
$^1$H NMR (400 MHz, CDCl$_3$)

7h $^1$H NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR ZY-4-S2B in CDCl$_3$

$^{13}$C NMR (100 MHz, CDCl$_3$)
$^{31}$P NMR ZY-4-52B in CDCl$_3$

$7h$ $^{31}$P NMR (162 MHz, CDCl$_3$)
$^1$H NMR ZY-4-52C in CDCl$_3$
13C NMR ZY-4-S2C in CDCl3

7i $^{13}$C NMR (100 MHz, CDCl3)
$^{31}$P NMR ZY-4-52C in CDCl$_3$

$^{31}$P NMR (162 MHz, CDCl$_3$)
$^{1}H$ NMR ZY-4-55A In CDCl₃

$^{1}H$ NMR (400 MHz, CDCl₃)
$^{13}$C NMR ZY-4-55A in CDCl$_3$

1g $^{13}$C NMR (100 MHz, CDCl$_3$)
19F NMR of 1g in CDCl3
$^{31}$P NMR ZY-4-55A in CDCl₃

![Chemical Structure](image)

$^{31}$P NMR (162 MHz, CDCl₃)
$^1$H NMR (400 MHz, CDCl$_3$)

1H NMR ZY-4-568 in CDCl$_3$
$^{13}$C NMR (100 MHz, CDCl$_3$)
$^{31}$P NMR (162 MHz, CDCl$_3$)

$\text{Cl}$

$\text{PO(O(iPr)$_2$}$

$\text{N}$

$\text{SO}$

$\text{O}$

$\text{SO}$

$\text{N}$

$\text{Cl}$

$^{1}h$ $^{31}$P NMR (162 MHz, CDCl$_3$)
$^{1}H$ NMR (400 MHz, CDCl$_3$)

$^{1}H$ NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR ZY-4-57A in CDCl$_3$
$^{31}$P NMR ZY-4-57A in CDCl$_3$

$^1$H $^{31}$P NMR (162 MHz, CDCl$_3$)
$^1$H NMR (400 MHz, CDCl$_3$)

2a $^1$H NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR ZY-3-57B in CDCl$_3$

![Chemical Structure and NMR Spectra]
$^{31}P$ NMR ZY-3-57B in CDCl$_3$

$2a^{31}P$ NMR (162 MHz, CDCl$_3$)
$^{1}H$ NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR (100 MHz, CDCl$_3$)
$31^P$ NMR ZY-3-59A in CDCl$_3$

$2b \ 31^P$ NMR (162 MHz, CDCl$_3$)
$^1$H NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR ZY-3-59B in CDCl$_3$

$^{13}$C NMR (100 MHz, CDCl$_3$)

$^{13}$C NMR (100 MHz, CDCl$_3$)
$^{31}P$ NMR of 2c in CDCl$_3$
$^1$H NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR ZY-3-60E in CDCl₃

2d $^{13}$C NMR (100 MHz, CDCl₃)
$^{31}$P NMR ZY-3-60E in CDCl$_3$

2d $^{31}$P NMR (162 MHz, CDCl$_3$)
$^{13}$C NMR ZY-3-60C in CDC$_3$

$^{13}$C NMR (100 MHz, CDC$_3$)
$^{31}$P NMR ZV-3-60C in CDCl$_3$

![Chemical Structure](image)

$2e$ $^{31}$P NMR (162 MHz, CDCl$_3$)
$^{1}H$ NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR ($100$ MHz, CDCl$_3$)

$2f$ $^{13}$C NMR ($100$ MHz, CDCl$_3$)
$^{31}$P NMR ZY-3-60F in CDCl$_3$

2f $^{31}$P NMR (162 MHz, CDCl$_3$)
1H NMR ZY-4-578 in CDCl₃

2g ¹H NMR (400 MHz, CDCl₃)
$^{19}$F NMR ZY-4-57B in CDCl$_3$

$^{19}$F NMR (367 MHz, CDCl$_3$)

$^{19}$F NMR (367 MHz, CDCl$_3$)
$^{31}$P NMR (162 MHz, CDCl$_3$)

$\text{PhSO}_2\text{NHPh}$

$\text{Ph}^2\text{PO(OiPr)$_2$}$

$^{29}$P NMR (162 MHz, CDCl$_3$)

$\text{f$_1$ (ppm)}$
$^{1}H$ NMR (400 MHz, CDCl$_3$)

$^{1}H$ NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR (100 MHz, CDCl$_3$)
$^{31}$P NMR ZY-4-59B in CDCl$_3$

$^{31}$P NMR (162 MHz, CDCl$_3$)

$2^h$ $^{31}$P NMR (162 MHz, CDCl$_3$)
1H NMR ZY-4-608 in CDCl₃

2i ¹H NMR (400 MHz, CDCl₃)
$^{13}$C NMR ZY-4-60B in CDCl$_3$
31P NMR ZY-4-60B in CDCl3

21 \(^{31}\)P NMR (162 MHz, CDCl3)
$^1$H NMR ZY-3-60D in CDCl$_3$
$^13$C NMR of $ZY$-3-60D in CDCl$_3$
$^{31}$P NMR ZY-3-60D in CDCl$_3$
1H NMR ZY-3-62A in CDCl3

2k \(^1\)H NMR (400 MHz, CDCl3)
$^{13}$C NMR ZY-3-62A in CDCl₃

$^{13}$C NMR (100 MHz, CDCl₃)
$^{31}$P NMR ZY-3-62A in CDCl$_3$

$^{2k}$$^{31}$P NMR (162 MHz, CDCl$_3$)
$^{1}H$ NMR (400 MHz, CDCl$_3$)

$^{2}l$ $^{1}H$ NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR ZY-3-62B In CDCl$_3$

![NMR spectrum](image)
$\text{\textit{31}P NMR ZY-3-62B In CDCl}_3$
$^1$H NMR ZY-3-G7A in CDCl$_3$
$^{13}$C NMR ZY-3-67A in CDCl$_3$

![Chemical Structure](image)

$^{13}$C NMR (100 MHz, CDCl$_3$)

![NMR Spectra](image)
$^{31}P$ NMR ZY-3-67A in CDCl$_3$

2m $^{31}P$ NMR (162 MHz, CDCl$_3$)
$\text{S72}$

$^1\text{H NMR (400 MHz, CDCl}_3\text{)}$

$\text{1H NMR ZY-3-71A in } \text{CDCl}_3$

$\text{2n } ^1\text{H NMR (400 MHz, CDCl}_3\text{)}$

$\text{Me-PO(O/Pr)_2}$

$\text{Me}$

$\text{NH}$

$\text{SO}$

$\text{O}$

$\text{PO(O/Pr)_2}$

$\text{Me}$

$\text{Me}$
$^{13}$C NMR (100 MHz, CDCl$_3$)

![Chemical structure and NMR spectra](image)
$^{31}$P NMR ZY-3-71A in CDCl$_3$

![Chemical structure](image)

$2n$ $^{31}$P NMR (162 MHz, CDCl$_3$)
$^1$H NMR ZY-3-G3C in CDCl$_3$
$^{13}$C NMR ZY-3-63C in CDCl$_3$

$2a^{13}$C NMR (100 MHz, CDCl$_3$)
$^{31}P$ NMR of $2a$ in CDCl$_3$
$1^{19}F$ NMR ZY-3-63C in CDCl$_3$
$\text{S79}$

$\text{2p}^1 \text{H NMR (400 MHz, CDCl}_3\text{)}$

$\text{1H NMR ZY-3-63D in CDCl}_3$
$^{13}$C NMR 2-p-53D in CDCl$_3$

$2p^{13}$C NMR (100 MHz, CDCl$_3$)
$^{31}$P NMR ZY-3-63D in CDCl₃

2p $^{31}$P NMR (162 MHz, CDCl₃)
$^1$H NMR (400 MHz, CDCl$_3$)
\( 13^C \text{ NMR} \ ZY-3-63E \text{ in CDCl}_3 \)

\[ \text{Structure:} \]

\[ \text{NMR:} 13^C \text{ NMR} (100 \text{ MHz, CDCl}_3) \]

\[ \text{S83} \]
$^{31}$P NMR ZY-3-63E in CDCl$_3$

2q $^{31}$P NMR (162 MHz, CDCl$_3$)
$^1$H NMR ZY-3-64H in CDCl₃

2$^t$H NMR (400 MHz, CDCl₃)
$^{13}$C NMR ZY-3-64H in CDCl$_3$

![NMR Spectrum](image)

$^{13}$C NMR (100 MHz, CDCl$_3$)
$^{31}$P NMR ZY-3-64H in CDCl$_3$

$2r^{31}$P NMR (162 MHz, CDCl$_3$)
$^{1}H$ NMR (400 MHz, CDCl$_3$)

$^{31}P$ NMR (121 MHz, CDCl$_3$)

$^{13}C$ NMR (100 MHz, CDCl$_3$)

4a $^{1}H$ NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR (100 MHz, CDCl$_3$)

![Chemical Structure](image)

$^{13}$C NMR (100 MHz, CDCl$_3$)

Chemical Shifts:
- 129.0
- 128.5
- 128.0
- 127.5
- 127.0
- 126.5
$^{31}\text{P} \text{NMR}$ ZY-3-72A in CDCl$_3$

4a $^{31}\text{P} \text{NMR}$ (162 MHz, CDCl$_3$)
$^1$H NMR (400 MHz, CDCl$_3$)
$^{31}$P NMR (162 MHz, CDCl$_3$)
$\text{1H NMR} \; \text{ZY-3-73C in CDCl}_3$

![NMR spectrum diagram]

$4c \; \text{1H NMR (400 MHz, CDCl}_3)$
13C NMR ZY-3-73C in CDCl3

4c $^{13}$C NMR (100 MHz, CDCl₃)
$^{31}\text{P NMR (}162\text{ MHz, CDCl}_3\text{)}$
$^{1}H$ NMR (400 MHz, CDCl$_3$)

4d $^{1}H$ NMR (400 MHz, CDCl$_3$)
$^{31}P$ NMR ZY-3-73 in CDCl$_3$

![Chemical Structure Image]

$4d$ $^{31}P$ NMR (162 MHz, CDCl$_3$)
$^{1}H$ NMR (400 MHz, CDCl$_3$)
$^{13}$C NMR (100 MHz, CDCl$_3$)

![NMR Spectra](image)

**Formula:**

```
Me
\[ \text{PO(OiPr)$_2$} \]
```

**Peak Assignments:**

- 130.0 ppm
- 129.0 ppm
- 128.0 ppm
- 127.0 ppm
- 126.0 ppm

**Chemical Structure:**

![Chemical Structure](image)
$^{31}$P NMR $Z^*$-$365$ in CDCl$_3$
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Last changed: 6/25/2016 6:34:10 PM
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Last changed: 6/25/2016 6:34:10 PM
Sample Info: AD-N, Hex/AcOH = 50/50, 0.7 mL/min, 30°C, 220 nm

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Injection Time: 10:28:12 AM

Analysis Method: 1
Location: Vial 1
Injection Date: 10/23/2015 10:28:12 AM
Injection Time: 10:28:12 AM

Sample Info:
27-3-628

--- End of Report ---

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Injection Time: 10:28:12 AM

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Location: Vial 1
Injection Date: 10/23/2015 10:28:12 AM
Injection Time: 10:28:12 AM

Analysis Method: 1
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Injection Time: 10:28:12 AM

Sample Info:
27-3-628

--- End of Report ---

S114
Data File (C:\CHEMXI\DATA\1809-15YEM10964.D)
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Last changed : 10/28/2015 10:51:31 AM

Analysis Method : C:\CHEMXI\DATA\15YEM10964.D
Last changed : 10/28/2015 10:51:31 AM

Sample Info : 27-3-63
$\text{NH}_2\text{S}$O$_2$PO(O$i$Pr)$_2$Me

**End of Report**