Supporting Information for

Asymmetric Oxidation of a Dihydrothienopyrimidine

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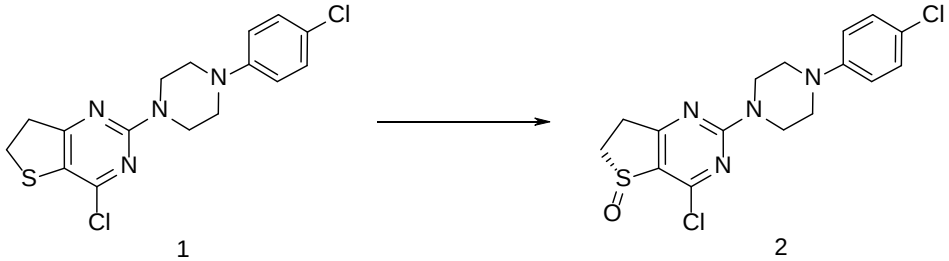
Table of Contents

1. General

Reagents were used as purchased without further purification. NMR spectra were recorded on a Bruker 400 MHz spectrometer. The chemical shift data are reported as δ (ppm) downfield from tetramethylsilane which is used as an internal standard; coupling constants (*J*) are reported in Hertz, and refer to apparent peak multiplicities. HPLC analysis was performed on an Agilent 1100 series using an Agilent XDB-C18 column; flow rate 2 mL/min; with a UV detection at 215 nm; mobile phase from 48% to 97% acetonitrile in water (0.1% $HClO_4$) in 1.3 min, then hold to 97% for 1.2 min. Enantioselectivities were measured on an Agilent 1100 series using a chiralpak AD-H column; flow rate 1 mL/min; with a UV detection at 220 nm; mobile phase 20% isopropanol in heptane for 10 min.

2. General experimental procedure for DOE studies

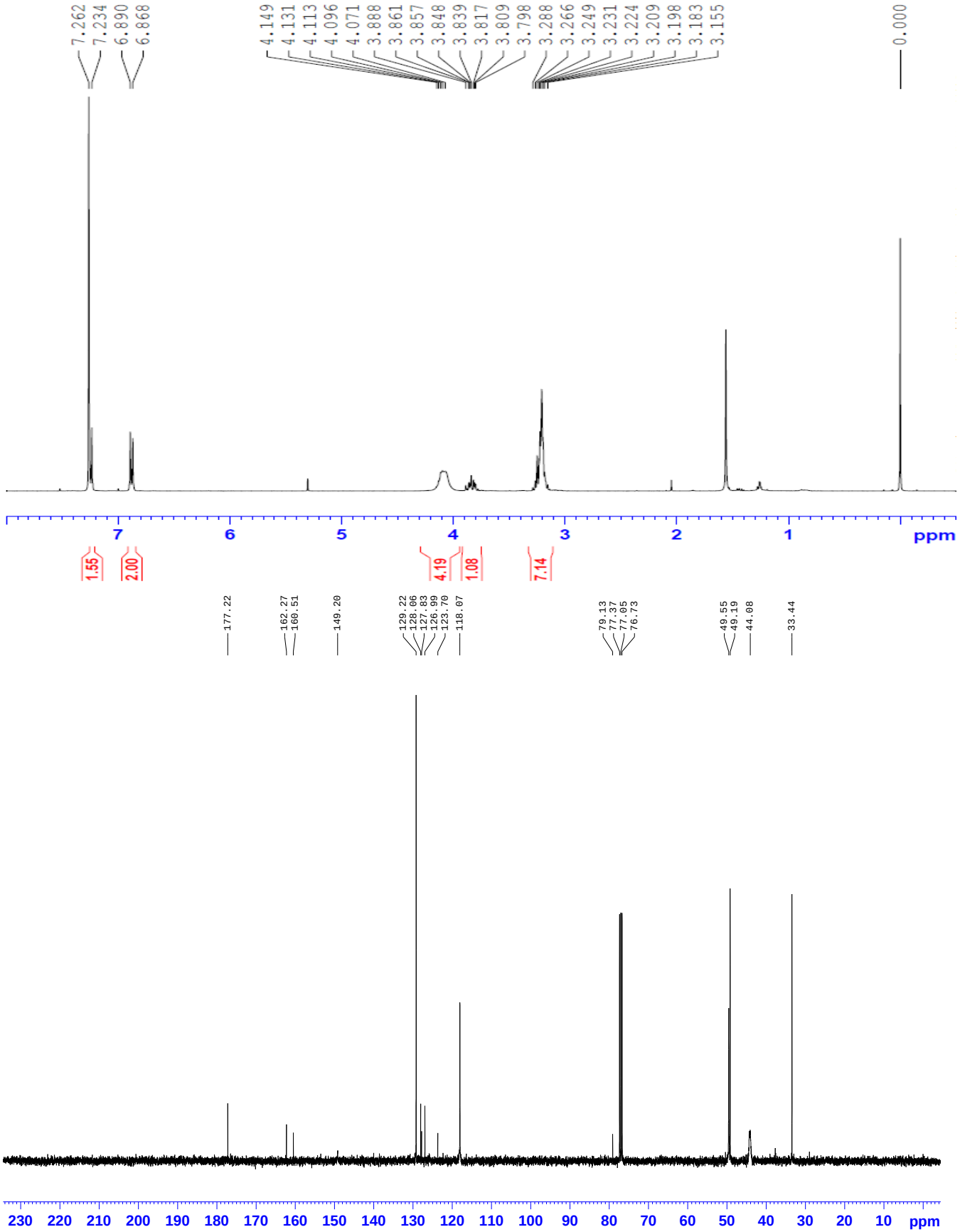


1 2

Titanium(IV) isopropoxide (5-20 mol%) was added to (*S*,*S*)-hydrobenzoin (10-40 mol%) in toluene at 23 °C followed by water (0-1.5 equiv). After stirring for certain time (0.5-2 h), the sulfide **1** (1.0 equiv) was added, and the reaction mixture was cooled to 0°C over 30 min before addition of *tert*-butyl hydroperoxide (2 equiv). After 24 h, the reaction mixture was quenched with 5% Na_2SO_3 (5 mL) and extracted with dichloromethane (10 mL). The combined organic layers were washed with water (5 mL), dried ($MgSO_4$) and concentrated. The crude reactions were analyzed by HPC and NMR.

Entry	Catalyst preparation time (h)	Catalyst loading (mol%)	Water (equiv)	Conversion (%)	ee (%)
1	0.5	5	0	97	88
2	2	5	0	90	94
3	0.5	20	0	88	95
4	2	20	0	93	94
5	0.5	5	1.5	89	90
6	2	5	1.5	90	92
7	0.5	20	1.5	95	97
8	2	20	1.5	90	64
9	1.25	12.5	0.78	92	82
10	0.5	5	1	88	93
11	0.5	5	1	95	89
12	0.5	5	1	92	90
13	0.5	5	1	90	91

3. NMR Spectra of (*R*)-4-chloro-2-(4-(4-chlorophenyl)piperazin-1-yl)-6,7-dihydrothieno[3,2-d]pyrimidine 5-oxide, 2


7.262
7.234
6.890
6.868
4.149
4.131
4.113
4.096
4.071
3.888
3.861
3.857
3.848
3.839
3.817
3.809
3.798
3.288
3.266
3.249
3.231
3.224
3.209
3.198
3.183
3.155
0.000
7
6
5
4
3
2
1
ppm
1.55
2.00
4.19
1.08
7.14
177.22
162.27
160.51
149.20
129.22
128.06
127.83
126.99
123.70
118.07
79.13
77.37
77.05
76.73
49.55
49.19
44.08
33.44
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm