LIST of SUPPORTING INFORMATION

Readily Prepared Chiral P,N Ligands and Their Applications in Cu-Catalyzed Enantioselective Conjugate Additions

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Determination of enantiomeric excesses

(±)-1,3-diphenyl-pentan-1-one: Daicel Chiralpak AD, 5.0 μm , 25 cm x 0.46 cm (i.d.), *i*-PrOH / hexanes = 5 : 95, 0.5 mL / min, T_R = 10.86 and 12.78 min.

(±)-3-(4-chloro-phenyl)-1-phenyl-pentan-1-one: Daicel Chiralpak AD, *i*-PrOH / hexanes = 5 : 95, 0.5 mL / min, T_R = 11.60 and 15.62 min.

(±)-1-(4-chloro-phenyl)-3-phenyl-pentan-1-one: Daicel Chiralpak AD, *i*-PrOH / hexanes = 5 : 95, 0.5 mL / min, T_R = 12.22 and 14.81 min.

(±)-3-(4-methyl-phenyl)-1-phenyl-pentan-1-one: Daicel Chiralpak AD, *i*-PrOH / hexanes = 5 : 95, 0.5 mL / min, T_R = 10.10 and 13.37 min.

(±)-1-(4-methyl-phenyl)-3-phenyl-pentan-1-one: Daicel Chiralpak AD, *i*-PrOH / hexanes = 5 : 95, 0.5 mL / min, T_R = 13.16 and 18.32 min.

(±)-3-(4-methoxy-phenyl)-1-phenyl-pentan-1-one: Daicel Chiralpak AD, *i*-PrOH / hexanes = 5 : 95, 0.5 mL / min, T_R = 13.93 and 19.54 min.

(±)-1-(4-methoxy-phenyl)-3-phenyl-pentan-1-one: Daicel Chiralpak AD, *i*-PrOH / hexanes = 10 : 90, 0.8 mL / min, T_R = 10.14 and 14.82 min.

(±)-4-phenyl-hexan-2-one: Supelco Gamma-DEX-225 (30 m x 0.25 mm (i.d.)), at 110 °C constant, T_R = 25.01 and 26.34 min.

(±)-3-ethyl-cyclohexan-1-one: Supelco Gamma-DEX-225 (30 m x 0.25 mm (i.d.)), at 70 °C for 50 min, then programmed to increase at 5 °C / min to 120 °C, T_R = 51.75 and 53.27 min

(±)-3-ethyl-cycloheptan-1-one: Supelco Gamma-DEX-225(30 m x 0.25 mm (i.d.)), at 70 °C for 10 min, then programmed to increase at 1 °C / min to 110 °C, $T_R = 45.14$ and 45.51 min

¹H NMR (HYC-4-12 in DMSO-d6)

¹³C NMR (HYC-4-12 in DMSO-d6)

¹H NMR (HYC-4-11 in DMSO-d6)

¹³C NMR (HYC-4-11 in DMSO-d₆)

¹H NMR (HYC-4-13 in DMSO-d₆)

¹³C NMR (HYC-4-13 in DMSO-d₆)

¹H NMR (YHC-3-15 in DMSO-d6)

¹³C NMR (4a in DMSO-d₆)

³¹P NMR (HYC-3-15 in DMSO-d₆)

144.857

ppm

¹H NMR (HYC-3-14 in DMSO-d₆)

¹³C NMR (HYC-3-14 in DMSO-d₆)

³¹P NMR (HYC-3-14 in DMSO-d₆)

4N_021114-8 hyc-3-16-4c
Pulse Sequence: s2pul

4N_021114-4 hyc-3-16-4c
Pulse Sequence: s2pu1

(S,S)-4c

146.609

300 250 200 150 100 50 0 -50 -100 -150 -200 -250 ppm

4N_021118-1 HYC-4d

4N_021118-2 hyc-4d
Pulse Sequence: s2pul

³¹P NMR (HYC-3-25 in DMSO-d₆)