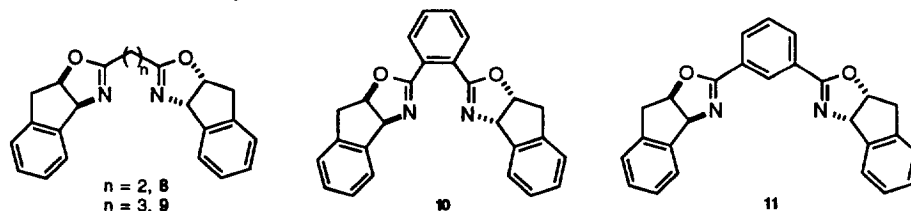


yield respectively. Similarly, 1,2-dicyanobenzene gave bis(oxazoline) **10** in 51% yield and 1,3-dicyanobenzene gave bis(oxazoline) **11** in 49% yield.⁶



These bis(oxazolines) contain a conformationally constrained phenyl glycinol unit⁷ which we have recently shown provides high levels of diastereocontrol in Diels-Alder reactions in contrast to acyclic analogues.⁸ The facile synthesis of the ligands described in this paper now allows for investigation of the aminoindanol sub-unit as a stereocontrol element in catalytic processes.

In summary, we have described a novel approach for the construction of bis(oxazoline) ligands in a single step from readily available materials. The simplicity of this reaction allows for rapid construction of ligands having different steric and electronic properties. We are currently investigating the use of these ligands in asymmetric Diels-Alder reactions and other catalytic processes. The results from these studies will be reported in due course.

References

- For pioneering work in this area see: Evans, D. A.; Murry, J. A.; von Matt, P.; Norcross, R. D.; Miller, S. *J. Angew. Chem., Int. Ed. Engl.* **1995**, *34*, 798; Evans, D. A.; Woerpel, K. A.; Hinman, M. M.; Faul, M. M. *J. Am. Chem. Soc.* **1991**, *113*, 726; Evans, D. A.; Faul, M. M.; Bilodeau, M. T.; Anderson, B. A.; Barnes, D. M. *J. Am. Chem. Soc.* **1993**, *115*, 5328. For related studies see: Bolm, C. *Angew. Chem., Int. Ed. Engl.* **1991**, *30*, 542; Lowenthal, R. E.; Abiko, A.; Masamune, S. *Tetrahedron Letters* **1990**, *31*, 6005.; Muller, D.; Umbricht, G.; Weber, B.; Pfaltz, A. *Helv. Chim. Acta* **1991**, *74*, 232; Nishiyama, H.; Itoh, Y.; Matsumoto, H.; Park, S.; Itoh, K. *J. Am. Chem. Soc.* **1994**, *116*, 2223.
- For leading references see: Denmark, S. E.; Nakajima, N.; Nicaise, O. J.; Faucher, A-M.; Edwards, J. P. *J. Org. Chem.* **1995**, *60*, 4884.
- Maligrès, P. E.; Upadhyay, V.; Rossen, K.; Ciancosi, S. J.; Purick, R. M.; Eng, K. K.; Reamer, R. A.; Askin, D.; Volante, R. P.; Reider, P. J. *Tetrahedron Letters* **1995**, *36*, 2195.
- Senanayake, C. H.; Roberts, F. E.; DiMichele, L. M.; Ryan, K. M.; Liu, J.; Fredenburgh, L. E.; Foster, B. S.; Douglas, A. W.; Larsen, R. D.; Verhoeven, T. R.; Reider, P. J. *Tetrahedron Letters* **1995**, *36*, 3993; Senanayake, C. H.; DiMichele, L. M.; Liu, J.; Fredenburgh, L. E.; Ryan, K. M.; Roberts, F. E.; Larsen, R. D.; Verhoeven, T. R.; Reider, P. J. *Tetrahedron Letters* **1995**, *36*, 7615.
- General Procedure:** To a suspension of *1S,2R*-indan diol (15 mmol) and dinitrile (5 mmol) in dichloromethane (30 mL) at -40 °C was added dropwise trifluoromethanesulfonic acid (45 mmol) to give a homogeneous solution. The reaction was allowed to reach room temperature overnight. The dark solution was cooled to 5 °C and then poured into ice-cold saturated Na₂CO₃. The layers were separated, and the organic layer was washed with sat. Na₂CO₃, then water. The organic phase was dried (Na₂SO₄) and evaporated. Column chromatography on silica gel (ethyl acetate/hexane) and crystallization (acetonitrile) gave the analytically pure bis(oxazoline). Representative data: **4** [α]_D²² -377 (c = 1, CH₂Cl₂); m.p. 215-217 °C; Found: C, 75.98; H, 5.69; N, 8.47; C₂₁H₁₈N₂O₂ requires: C, 76.34; H, 5.49; N, 8.48; ¹H NMR (300MHz, CDCl₃) δ 7.51-7.42(2H, m), 7.31-7.21(6H, m), 5.57(2H, d, *J* = 9), 5.35(2H, dt, *J* = 9, 1.5), 3.40(2H, dd, *J* = 18, 7.5), 3.28(2H, s), 3.18(2H, dd, *J* = 18, 1). **6** [α]_D²² -453 (c = 1, CH₂Cl₂); m.p. 189-190 °C; Found: C, 76.90; H, 6.13; N, 7.68; C₂₃H₂₂N₂O₂ requires: C, 77.01; H, 6.19; N, 7.82. ¹H NMR (300MHz, CDCl₃) δ 7.52-7.45 (2H, m), 7.30-7.19(6H, m), 5.51(2H, d, *J* = 9), 5.23(2H, dt, *J* = 9, 2.5), 3.29(2H, dd, *J* = 17, 7), 2.93(2H, d, *J* = 17), 1.42(6H, s). The ligands **4** and **6** were found to be identical in all respects to those prepared independently from *1S,2R*-1-amino indan-2-ol, thus establishing both the absolute and relative stereochemistry.
- For related ligands see: Bolm, C.; Weickhardt, K.; Zehnder, M.; Ranff, T. *Chem. Ber.* **1991**, *124*, 1173.
- Davies, I. W.; Senanayake, C. H.; Castonguay, L.; Larsen, R. D.; Verhoeven, T. R.; Reider, P. J. *Tetrahedron Letters* **1995**, *36*, 7619.
- Aminoindanol has found related uses: Ghosh, A. K.; Chen, Y. *Tetrahedron Letters* **1995**, *36*, 6811.