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A useful Preparation of Pyrroles from α,β-unsaturated Sulfones

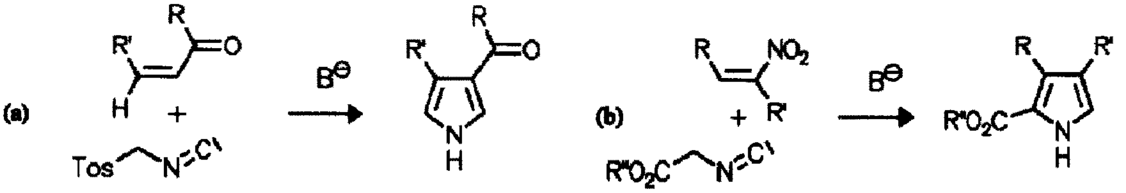
Gerold Haake, Daria Struve, Franz-Peter Montforts*

Institut für Organische Chemie FB 2, Universität Bremen, Leobener Str. NW 2,
D-28359 Bremen, Germany

Abstract: The addition of alkyl isocyanoacetate to α,β-unsaturated sulfones, which are easily obtained from olefins, affords a convenient access to pyrroles with unusual substitution patterns.

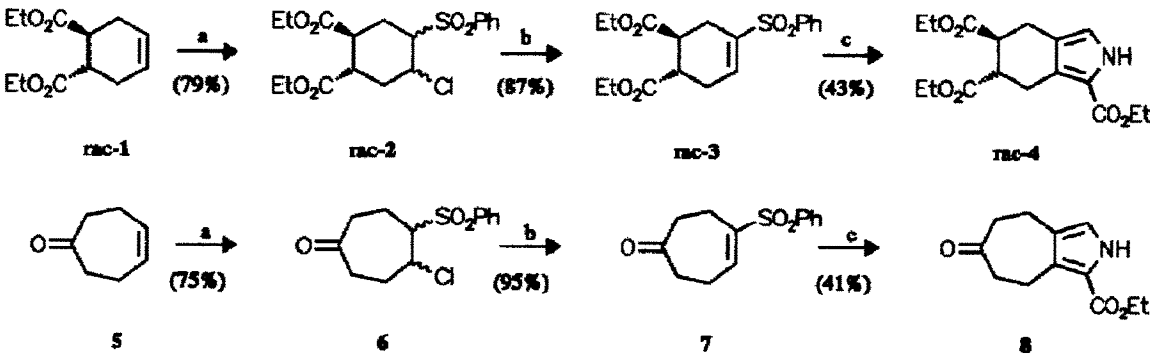
Pyrrole itself and substituted pyrroles are important starting materials for the synthesis of naturally occuring porphinoid compounds[1] and other porphyrins. For instance, the synthesis of new types of porphyrin derivatives with altered or extended chromophores[2] or unusual substitution patterns[3] affords new pyrrolic subunits.

In the course of our studies directed towards the synthesis of new chlorins (dihydroporphyrins) the pyrroles **4** and **8** were required as building blocks. Obviously none of the various classical pyrrole syntheses[4] were suitable for our purposes to prepare *rac*-**4** and **8**. The methods of van Leusen[5] and Barton[6], which are based on the work of Schöllkopf[7] and have become important tools in pyrrole synthesis, led to the solution of our synthetic problem.



Scheme 1: Synthesis of pyrroles according to (a) van Leusen[5] and (b) Barton[6].

According to van Leusens method pyrroles are obtained by addition of tosylmethyl isocyanide (TosMIC) to α,β-unsaturated carbonyl compounds in the presence of base. Mechanistically the pyrrole ring is formed by 1.4-addition of the deprotonated isocyanide to the unsaturated carbonyl compound followed by nucleophilic attack of the enolate anion to the isocyanide carbon atom. Elimination of the tosyl group and tautomerisation yields the aromatic system (s. scheme 1a). Barton's method makes use of alkyl isocyanoacetates and nitroolefins instead of TosMIC and α,β-unsaturated carbonyl compounds. In this case the nitro function makes 1.4-addition possible, stabilizes the intermediate anion and serves as leaving group to yield the pyrrole (s. scheme 1b).



Scheme 2: a: 1) 1.1 eq. PhSCl, CH_2Cl_2, -15°C to rt, 20 min; 2) 1.9-3 eq. Oxone®, H_2O, MeOH, rt 1-2 h. b: 1.1 eq DBU, CH_2Cl_2, 0°C to rt, 0.5-1 h. c: 1) 1.1 eq $CNCH_2CO_2Et$, THF, rt; 2) 2.2 eq. t-BuOK, THF, rt, 3-12 h.

The desired pyrroles *rac*-**4** and **8** are obtained from the α,β-unsaturated sulfones *rac*-**3** and **7** by addition of alkyl isocyanoacetates in the presence of base[8]. The phenylsulfonyl group has the same function as the nitro group in Barton's method, but has the advantage that it may be introduced more conveniently. For this purpose the readily available olefins *rac*-**1**[9] and **5**[10] were treated with phenylsulfenyl chloride, followed by oxidation of the sulfides to the corresponding sulfones *rac*-**2** and *rac*-**6**. The phenylsulfonyl function allows elimination under mild conditions to yield the α,β-unsaturated sulfones *rac*-**3** and **7**. The described method should provide a general access to pyrroles starting from readily available olefins.

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References and Notes

1 . a: Dolphin, D. (Ed.) The Porphyrins; Academic Press: New York, 1978-1979; vols. I-VII;
b: Montforts, F.-P., Gerlach, B., Höper, F. *Chem. Rev.* **1994**, *94*, 327-347.
2 . Sessler, J. *Angew. Chem. Int. Ed. Engl.* **1994**, *33*, 1348-1350.
3 . Medforth, C.J., Senge, M.O., Smith, K.M., Sparks, L.D., Shelnutt, J.A. *J. Am. Chem. Soc.* **1992**, *114*, 9859-9869.
4 . a: Gossauer, A. *Die Chemie der Pyrrole;* Springer: Berlin, 1974;
b: Jones, R. A., Bean, G. P. *The Chemistry of Pyrroles;* Academic Press: London, 1977.
5 . van Leusen, A. M., Siderius, H., Hoogenboom, B. E., van Leusen, D. *Tetrahedron Lett.* **1972**, *52*, 5337-5340.
6 . Barton, D. H. R., Kervagoret, J., Zard, S. Z. *Tetrahedron* **1990**, *46*, 7587-7598.
7 . Schöllkopf, U. *Angew. Chem. Int. Ed. Engl.* **1977**, *16*, 339-348.
8 . To our knowledge the use of α,β-unsaturated sulfones in the preparation of pyrroles is documented by one example in which 1-phenylsulfonyl-1,3-butadiene was reacted twice with isonitriles to yield a bypyrrolic intermediate, used for the synthesis of the naturally occuring antitumor agent CC-1065: Magnus, P., Halazy, P. *Tetrahedron Lett.* **1984**, *25*, 1421-1424.
9 . Prepared from diethylfumarate and sulfolene in 90% yield.
10 . Wilson, S. R., Wiesler, D. P. *Synth. Commun.* **1980**, *10*, 339-343.

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