

Convenient, Efficient One-Pot Synthesis of Ferrocenylcyanide

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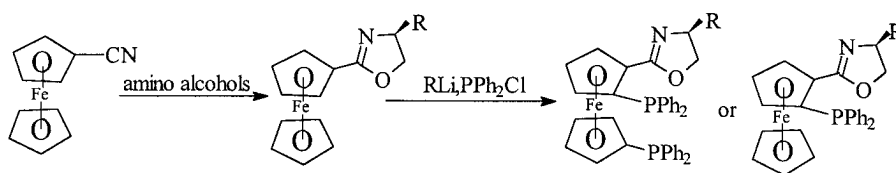
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Abstract: Convenient, efficient one-pot synthesis of ferrocenylcyanide, which is a very important intermediate in synthesis of chiral ferrocenyl ligands in asymmetric catalysis, is described. The chemical yield is up to 60%.

Keywords: Ferrocene, cyanide, synthesis.

In asymmetric catalysis, chiral (central chiral, planar chiral, axial chiral) ferrocenyl ligands is one of the most successful class of auxiliaries in recent years, and some of them have reached the stage of industrial applications¹. But many challenges remain for the synthesis of the intermediate. One of them is how to get ferrocenylcyanide **1** directly from ferrocenecarboxyaldehyde **2**, which can be easily prepared according to the corresponding literature². As far as known, **1** is an important intermediate for the synthesis of non-racemic ferrocene derivatives, and in particular the development of chiral ferrocenyl oxazolines ligands³⁻⁵, which introduce the highly diastereoselective lithiation and also are very important ferrocenyl ligands in asymmetric ferrocene (Scheme 1).

Scheme 1

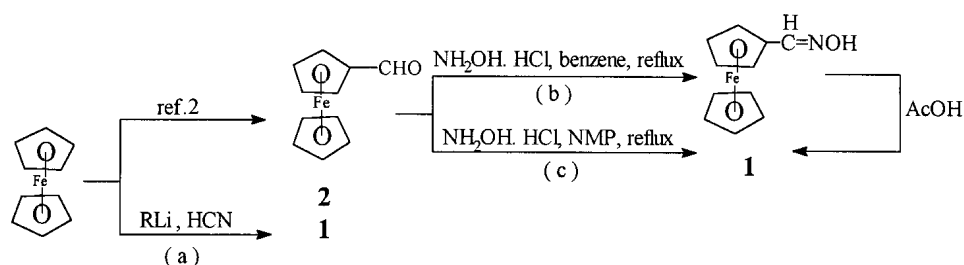


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Originally, compound **1** obtained by dehydration of ferrocenecarboxyaldoxime, which was prepared from compound **2**, in benzene⁶. The overall yield of this method is *ca.* 20%, with **2** as starting material. Another method is that the intermediate can also be obtained from the reaction of lithium ferrocenyl with HCN (chemical yield : 20%), which is known for its toxic danger to health⁷. However, the yields of the two methods are too low. Now, we wish to report an alternative method for preparation of **1**, that is route C in scheme 2.

When the compound **2** was refluxed with hydroxylamine hydrochloride in the presence of NMP (N-methylpyrrolidone) and Et₃N, it was converted into compound **1**. After purification, we can get the golden- yellow solid (chemical yield: 60%). The IR spectrum of the product shows the carbon-nitrogen triple-bond stretching region at 2252 cm⁻¹ (KBr disc), and the carbon-oxygen double-bond (1646 cm⁻¹) disappeared, with no band at 3420 cm⁻¹ (=N-OH).

Scheme 2



General Procedure

The solution of compound **2** (2.16 g, 10 mmol), 15 ml NMP and 2 ml Et₃N was stirred at r.t. for 30 min and to the solution was added 0.70 g (10 mmol) hydroxylamine hydrochloride ,then the mixture was heated to reflux and monitored by TLC. After the reaction was complete, the mixture was filtered off and washed by 2N NaOH two times and extracted with EtOAc.The combined organic layer was washed with water (2 × 10 ml),dried with Na₂SO₄. Evaporation of the solvent and crystallization of the residue from light petroleum (30-60°C) afforded **1** forming golden-yellow plates (1.4g, 60%).mp: 103-104°C.IR: 3050, 2980, 2252, 1600, 1450, 870 cm⁻¹.Anal Caclcd for C₁₁H₉NFe: C,62.6, H, 4.3, N, 5.8; Found: C, 62.4, H, 4.5, N, 5.6

References:

1. A.Togni, *Angew. Chem. Int. Ed. Engl.*,**1996**, 35, 1475.
2. P. L. Pauson, W. E. Watts., *J. Chem. Soc.*, **1962**, 3880
3. C. J. Richards, T. Damalidis, D. E. Hibbs, M. B. Hursthouse, *Synlett.*,**1995**, 74.
4. T. Sammakia, H. A. Latham, D. R. Schaad., *J. Org. Chem.*,**1995**, 60, 10.
5. Y. Nishibayashi, S. Uemura., *J. Chem. Soc.*, **1962**, 3880
6. G. D. Broadhead, J. M. Osgerby, P. L. Pauson. *J. Chem. Soc.*, **1958**, 650
7. W. F. Litter, A. K. Clark, *J. Org. Chem.*,**1960**, 25, 1979

Received 30 August 1999