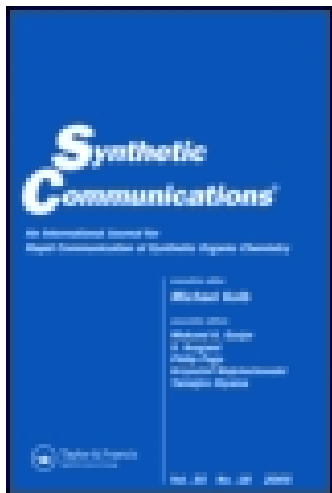


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Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/lcyc20>

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Published online: 21 Aug 2006.

To cite this article: Ja Seo Koo & Jae In Lee (1996) 2-Pyridyl Cyanate: A Useful Reagent for the Preparation of Nitriles, *Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry*, 26:20, 3709-3713, DOI: [10.1080/00397919608003787](https://doi.org/10.1080/00397919608003787)

To link to this article: <http://dx.doi.org/10.1080/00397919608003787>

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2-PYRIDYL CYANATE: A USEFUL REAGENT FOR THE PREPARATION OF NITRILES

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Abstract: The reaction of Grignard reagents with 2-pyridyl cyanate affords to give nitriles in high yields.

The reaction of organometallics with cyanate reagents appears to have potential for the synthesis of nitriles. Previous methods for preparing nitriles from organometallics are the use of cyanogen chloride,¹ cyanogen bromide,² and cyanogen³ which are highly volatile, toxic. The reaction of Grignard or RLi(R= vinyl, alkynyl) reagents with phenyl cyanate⁴ affords to give nitriles, but the separation of phenol is often tedious. *p*-Toluenesulfonyl cyanide⁵ has been also proposed as a cyanating reagent which converts functionalized organozinc halides into polyfunctional nitriles.

We now report that nitriles can be conveniently prepared from Grignard reagents using 2-pyridyl cyanate **1**. The reagent **1** was prepared by addition of

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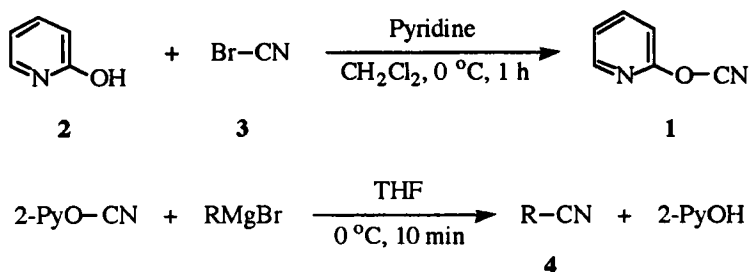
an equimolar solution of 2-hydroxypyridine **2** and pyridine in dichloromethane to a cyanogen bromide **3** at 0 °C (Scheme 1). The use of triethylamine as a base for the preparation of **1** led to competing von Braun degradation which produced by-product diethylcyanamide (20%). The reagent **1** was separated by dissolving in THF after evaporation of dichloromethane, followed by filtering off pyridinium hydrobromide and obtained in 90% yield after short pathway silica gel column chromatography.

The selective cyanation of a variety of Grignard reagents with **1** proceeded smoothly and there was no observable by-product such as the corresponding ketone. Furthermore, 2-hydroxypyridine is readily soluble in water and this method offers the advantage of the easy isolation of the product. As shown in Table 1, the reaction worked well with aliphatic (4a-4c) and aromatic Grignard reagents (4d-4g), including hindered 2,4,6-trimethylphenylmagnesium bromide (4h) and phenylethynylmagnesium bromide (4j). Significantly, *in situ* vinyl cyanocuprate (4i) was converted into α , β -unsaturated nitrile with retention of configuration. Treatment of **1** with (*trans*-C₆H₅CH=CH)₂Cu(CN)Li₂, generated from the transmetalation between *trans*-1-trimethylstannyl styrene and 0.55 equiv of Me₂Cu(CN)Li₂, gave *trans*-cinnamonitrile with none of *cis*-isomer detected by Glc.

Experimental

2-Pyridyl Cyanate **1**.

To a cyanogen bromide (3M in CH₂Cl₂, 4 mL, 12 mmol) in dichloromethane (12 mL) was slowly added an equimolar solution of 2-hydroxypyridine (1.1412 g, 12 mmol) and pyridine (0.97 mL, 12 mmol) in dichloromethane (20 mL) at 0 °C. After 1 h, dichloromethane was evaporated under vacuum and the reaction



Scheme 1.

Table 1. Preparation of Nitriles from 2-Pyridyl Cyanate and Grignard Reagents

4	RMgBr, R	R-CN	Yield, % ^b
a	CH ₃ (CH ₂) ₇	CH ₃ (CH ₂) ₇ CN	97
b	C ₆ H ₅ (CH ₂) ₃	C ₆ H ₅ (CH ₂) ₃ CN	83
c	<i>c</i> -C ₆ H ₁₁	<i>c</i> -C ₆ H ₁₁ CN	80
d	<i>p</i> -CH ₃ -C ₆ H ₄	<i>p</i> -CH ₃ -C ₆ H ₄ CN	95
e	<i>p</i> -CH ₃ O-C ₆ H ₄	<i>p</i> -CH ₃ O-C ₆ H ₄ CN	95
f	<i>p</i> -Cl-C ₆ H ₄	<i>p</i> -Cl-C ₆ H ₄ CN	93
g	α-Naphtyl	α-Naphtyl-CN	83
h	2,4,6-(CH ₃) ₃ -C ₆ H ₂	2,4,6-(CH ₃) ₃ -C ₆ H ₂ CN	89
i	<i>trans</i> -C ₆ H ₅ CH=CH ^a	<i>trans</i> -C ₆ H ₅ CH=CHCN	72
j	C ₆ H ₅ -C≡C	C ₆ H ₅ -C≡C-CN	81

^aThe reaction was carried out at -78 °C for 1.5 h using (*trans*-C₆H₅CH=CH)₂Cu(CN)Li₂. ^b Isolated and the products gave satisfactory spectral data.

mixture was dissolved in anhydrous THF(3 x 15 mL), followed by filtering off pyridinium hydrobromide. The filtrate was concentrated and purified by short pathway silica gel column chromatography(EtOAc/*n*-Hexane=1/1) to give 2-pyridyl cyanate(1.2971 g, 90%). FT-IR(neat) 3067, 2261, 1599, 1573, 1467, 1433, 1194, 777, 736 cm^{-1} ; $^1\text{H NMR}$ (300 MHz, CDCl_3) δ 8.31(d, 1H, J=4 Hz), 7.84-7.90(m, 1H), 7.30-7.34(m, 1H), 7.04(d, 1H, J=8 Hz); Ms m/z (%) 120(M^+ , 60), 118(20), 95(100), 78(94), 67(66), 51(31); HREIMS calcd for $\text{C}_6\text{H}_4\text{N}_2\text{O}$ 120.0324, found 120.0318

***p*-Methylbenzonitrile 4d. (typical procedure)**

To a 2-pyridyl cyanate(240.2 mg, 2 mmol) in THF(2 mL) was added *p*-methylphenylmagnesium bromide(0.40 M in THF, 5 mL, 2 mmol) at 0 °C under nitrogen atmosphere. After 10 min, the reaction mixture was quenched with sat. NH_4Cl (20 mL) and extracted with dichloromethane(3 x 15 mL), dried over MgSO_4 , filtered, and evaporated to dryness under vacuum. The crude product could be purified by Kugelrohr distillation(80-85 °C/8 mm) to afford 222.5 mg(95%) of *p*-methylbenzonitrile. FT-IR(neat) 3038, 2925, 2229, 1927, 1609, 1514, 817 cm^{-1} ; $^1\text{H NMR}$ (CDCl_3) δ 7.45(d, 2H, J=8 Hz), 7.19(d, 2H, J=8 Hz), 2.40(s, 3H).

Acknowledgement. We are grateful to the Duksung Women's University for financial support(1995).

References

1. a) Harrison, I. T. and Harrison, S. "Compendium of Organic Synthetic Methods," John Wiley & Sons, Inc. **1971**, *1*, pp. 457 & 470-471. b) Welle, R. A. and Brandsma, L. *Recl. Trav. Chim. Pays-Bas* **1973**, *92*, 667. c) Westmi-

- jze, H. and Vermeer, P. *Synthesis* **1977**, 784. d) Westmijze, H.; Kleijn, H.; Vermeer, P. *ibid.* **1978**, 454.
2. Compagnon, P. L. and Grosjean, B. *Synthesis* **1976**, 448.
3. a) Eastham, J. F. and Cannon, D. Y. *J. Org. Chem.* **1960**, 25, 1504. b) Zweifel, G.; Snow, J. T.; Whitney, C. C. *J. Am. Chem. Soc.* **1968**, 90, 7139.
4. a) Martin, D. and Rackow, S. *Chem. Ber.* **1965**, 98, 3662. b) Holm, A. and Høge-Jensen, E. *Acta Chem. Scand. B* **1974**, 28, 705. c) Murray, R. E. and Zweifel, G. *Synthesis* **1980**, 150.
5. Klement, I.; Lennick, K.; Tucker, C. E.; Knochel, P. *Tetrahedron Lett.* **1993**, 34, 4623.

(Received in Japan 13 February 1996)