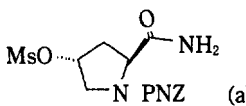
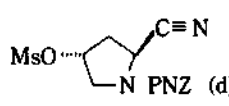
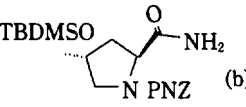
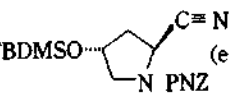
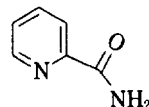
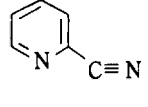
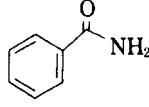
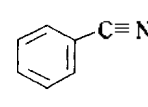


er field position (2R, 3S: 0.887-0.857, 2R, 3R: 0.938-0.908, 2S, 3R: 0.959-0.929).<sup>11</sup>

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15. **5**: <sup>1</sup>H-NMR (500 MHz, CDCl<sub>3</sub>) 0.96-1.09 (m, 9H), 1.38-1.47 (m, 1H), 1.69-1.75 (m, 2H), 1.86-1.97 (m, 2H), 2.08-2.24 (m, 2H), 2.75-2.97 (m, 4H), 3.67 (b, 1H), 3.85-3.89 (m, 1H).
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17. *anti-6a*: <sup>1</sup>H-NMR (270 MHz, CDCl<sub>3</sub>) 0.95-1.1 (m, 9H), 1.35-1.5 (m, 2H), 2.5-2.7 (m, 3H), 3.25 (br, 1H), 3.65, 3.80 (m, m, 1H), GC-MSD (HP-1) *anti-6a*: 29(45), 41(13), 55 (24), 57(100), 70(25), 86(19), 97(7), 115(10), 126(8), *syn-6a*: 29(42), 41(14), 55(16), 57(100), 70(14), 86(25), 97(10), 115 (5), 126(9). These <sup>1</sup>H-NMR and MS data consist with the data from literature<sup>13b</sup>.
18. To determine the absolute configuration and the ratio of enantiomers of **6a**, their (*S*)-(-)-MTPA ester **6b** were analyzed by GLC [DB-1701, 30 m×0.25 mm I.D., 0.25 μm d<sub>f</sub>, N<sub>2</sub>, 180°C (20 min) to 280°C (5°C/min)] and were compared to the data from the literature<sup>4</sup> (The absolute configuration of **6a** was confirmed by the coinjection of **6b** with the (*S*)-(-)-MTPA ester of synthetic racemic **6a**). The composition of **6a**: 4*S*, 5*S* (Rt 25.84 min, area 100%), 4*R*, 5*R* (Rt 25.96 min, area 0%).

**Table 1.** Preparation of Nitriles from Amides with trifluoromethanesulfonic Anhydride

Amides	Nitriles	Yield <sup>#</sup>
		84%
		78%
		90%
		65%

1) Ms: Methanesulfonyl, TBDMS: *tert*-butyldimethylsilyl, PNZ: *p*-Nitrobenzoyloxycarbonyl. 2) #: % yield purified by column chromatography. 3) Synthesis of Amides (a), (b): See ref. 19. 4) Identification Data of (d), (e): See ref. 18. 5) Synthesized cyanopyridine and benzonitrile were identified by comparison with known standards.

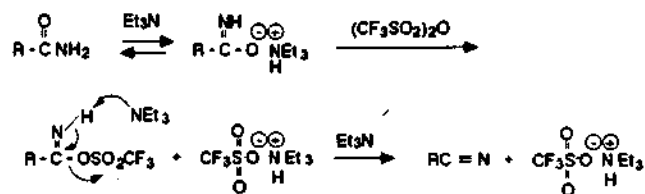
## Facile Conversion of Carboxamides to Nitriles

Jaekool Rhee\*, Joongin Lim, Weonbin Im, and Junnick Yang

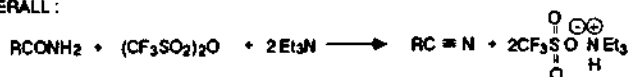
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Received November 3, 1992

The transformation of carboxamides into nitriles is well documented. The amides which can be converted to nitriles under relatively drastic conditions involving the basic reagents, include mesitamide with sodium hydroxide in refluxing ethylene glycol<sup>1</sup>, phenylacetamide with *n*-butyllithium<sup>2</sup>, benzamide with silazanes at 220°C<sup>3</sup>. On the other hand acidic reagents appear to offer milder conditions (at room temperature or below) and better yields: Trichloroacetyl chloride<sup>4</sup>, ethylpolyphosphate<sup>5</sup>, trimethylsilyl polyphosphate<sup>6</sup>, cyanuric chloride/dimethylformamide<sup>7</sup>, Vilsmeier reagent<sup>8</sup>, trifluoroacetic anhydride<sup>9</sup>, titanium tetrachloride<sup>10</sup>, triphenylphosphine<sup>11</sup>, boron trifluoride<sup>12</sup>, phosphoryl chloride/pyridine<sup>13</sup>, aluminum chloride<sup>14</sup>, chlorosulfonyl isocyanate<sup>15</sup>, thionyl chloride<sup>16</sup>. However, there still exists a need for the development of new, mild methods for the transformation. The trifluorome-



OVERALL:



**Scheme 1.**

thanesulfonyl ("triflyl") group has been shown to be an effective activator for sulfoxonium oxidation (dimethyl sulfide ditriflate by virtue of the exceptionally strong electron withdrawing capability of the triflyl group)<sup>16,17</sup>. The use of triphenylphosphine ditriflate as dehydrating reagent was demonstrated<sup>17</sup>. To our best knowledge, there has not been reported the direct application of trifluoromethanesulfonic anhydride for conversion of amides to nitriles. The conditions of present method used are mild (0°C or below), yields are high (see Table 1), and the reaction is complete within a short time (1 hour).

By analogy to the general mechanism proposed for this type of dehydration by a derivated acidic reagent, the reaction probably undergoes according to the pathway and the stoichiometry shown in the following scheme (Scheme 1).

## Experimental Section

A typical procedure is as follows: To a magnetically stirred

solution of the amide (a) (0.6 g, 3 mmole) and dry triethylamine (0.5 ml, 6 mmole) in dry dichloromethane (10 ml) at 0°C is added a solution of trifluoromethanesulfonic anhydride (0.3 ml, 3 mmole) in dichloromethane (2 ml). The reaction mixture is stirred for 1 hour at the same temperature, then allowed to warm to room temperature and poured into water. The dichloromethane layer is separated and the water layer is extracted three times with dichloromethane (3×25 ml). The organic layers are combined, washed with brine and dried over anhydrous sodium sulfate. Evaporation of the solvent gives the nitrile d, which is purified by flash column chromatography (ethyl acetate : hexane, 1 : 1).

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17. J. B. Hendrickson and S. M. Schwartzma, *Tetrahedron Lett.*, 277 (1975).
18. Nitrile (d): TLC ( $R_f$  0.4,  $\text{CHCl}_3$  : MeOH, 10 : 1), NMR (200 MHz,  $\text{CDCl}_3$ ): 8.21 (d, 2H), 7.56 (dd, 2H), 5.19-5.24 (m, 3H), 4.7 (t, 3H), 3.92 (dd, 1H), 3.78 (m, 1H), 2.8 (m, 1H), 2.62 (m, 1H). IR (KBr pellet) 2240  $\text{cm}^{-1}$ . Anal. Calcd. for  $\text{C}_{14}\text{H}_{15}\text{O}_7\text{N}_3$ : C, 45.52; H, 4.09; N, 11.38. Found: C, 45.48; H, 4.02; N, 11.24.  
Nitrile (e): TLC ( $R_f$  0.8,  $\text{CHCl}_3$  : MeOH, 10 : 1), NMR (200 MHz,  $\text{CDCl}_3$ ): 8.21 (d, 2H), 7.62 (dd, 2H), 5.2-5.24 (m, 3H), 4.61 (m, 1H), 4.5 (m, 1H), 3.5-3.58 (m, 2H), 2.56 (m, 2H), 0.9 (s, 9H), 0.05 (d, 6H). IR (KBr pellet) 2238  $\text{cm}^{-1}$ . Anal. Calcd. for  $\text{C}_{19}\text{H}_{29}\text{SiO}_5\text{N}_3$ : C, 56.15; H, 5.71; N, 10.36. Found: C, 56.15; H, 6.66; N, 10.48.
19. EP 272455 (1987) and JPN 60-233076.

### Partial Reduction of Aromatic Nitriles into Aldehydes by Sodium Diethylpiperidinoaluminumate

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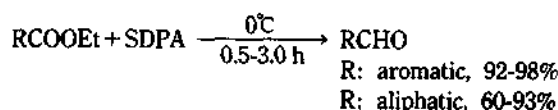
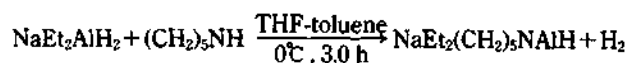
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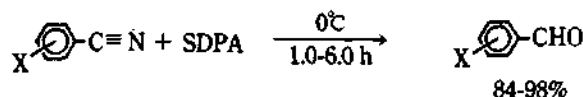
Partial reduction of nitrile function into aldehyde is important in organic synthesis, and many excellent reagents have been reported. Among the metal hydrides, lithium triethoxyaluminum hydride<sup>1</sup> and diisobutylaluminum hydride<sup>2</sup> have been utilized conveniently for this purpose. Recently lithium tris(dialkylamino)aluminum hydride<sup>3</sup> was reported as an attractive selective reducing agent for aromatic nitriles. This prompted us to report our result obtained by the reduction of aromatic nitriles with sodium diethylpiperidinoaluminumate (SDPA)<sup>4</sup>.



SDPA is readily prepared by the reaction of equimolar piperidine with sodium diethyldihydroaluminumate (SDDA) and exhibits excellent reducing ability of carboxylic acid esters to the corresponding aldehydes<sup>4</sup>.



We studied the reducing characteristics of SDPA and found it is also an excellent reducing agent for the partial reduction of aromatic nitriles to the corresponding aldehydes<sup>5</sup>.



The reduction of 4-chlorobenzonitrile is representative. An oven-dried 50 ml flask equipped with a rubber septum on an inlet port and an adaptor connected to a mercury bubbler was flushed with nitrogen and charged with 0.138 g (1.0 mmol) of 4-chlorobenzonitrile in 3.2 ml THF containing mesitylene as an internal standard. The flask was maintained at 0°C in an ice bath and 1.8 ml of 0.85 M SDPA (1.53 mmol) in THF-toluene was injected into the reaction flask with stirring. After 0.5 h, the reaction mixture was hydrolyzed with 10 ml of 2 N  $\text{H}_2\text{SO}_4$  and extracted with 3×10 ml of ether. The ether layer was dried over anhydrous potassium carbonate and analysis by GLC showed a 95% yield of 4-chlorobenzaldehyde. In a large scale reduction, 1.38 g (10 mmol) of 4-chlorobenzonitrile in 32 ml THF was reacted with 18 ml of 0.85 M (15.3 mmol) SDPA at 0°C for 0.5 h. The reaction mixture was hydrolyzed with 100 ml of 2 N  $\text{H}_2\text{SO}_4$  and extracted three times with 50 ml of ether. The ether layer was