

# Facile and One-Pot Synthesis of $\alpha$ -Aminonitriles by Strecker Reaction Catalyzed by [BMIM][PINO] as a New Ionic Liquid

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## Abstract

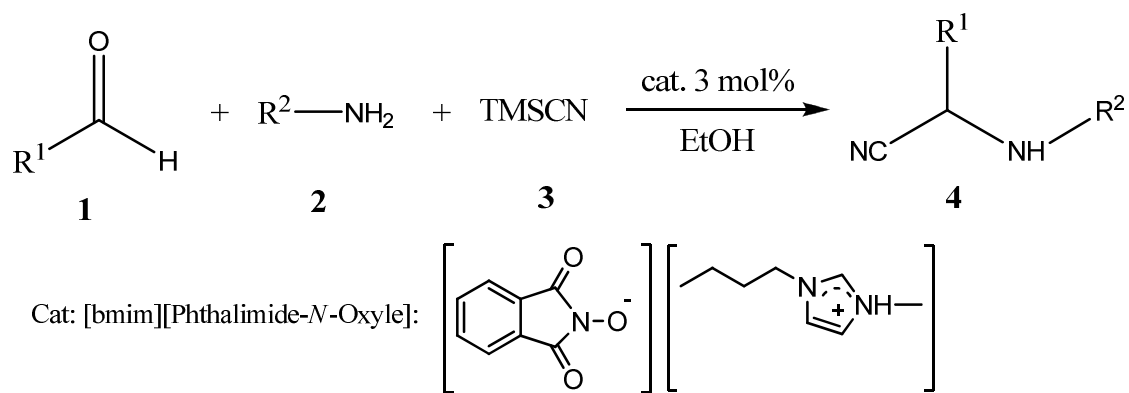
A simple, convenient, and practical method for the synthesis of  $\alpha$ -aminonitriles through a one-pot, three-component Strecker reaction of aromatic aldehydes and amines with trimethylsilyl cyanide (TMSCN) under mild conditions in EtOH has been developed. Reactions proceed efficiently in the presence of a catalytic amount of new and recoverable ionic liquid 1-butyl-3-methylimidazolium phthalimide-*N*-oxyl [BMIM][PINO] at room temperature.

**Keywords:**  $\alpha$ -Aminonitriles, Multicomponent reactions, Strecker reaction, Ionic Liquids, Trimethylsilyl cyanide, 1-Butyl-3-methylimidazolium phthalimide-*N*-oxyl

## 1. Introduction

The addition of cyanide to imines (the Strecker reaction) provides one of the most efficient methods for the synthesis of  $\alpha$ -aminonitriles.<sup>1</sup> The classical Strecker reaction is generally carried out with alkaline cyanides in aqueous solution. Among various cyanide ion sources, trimethylsilyl cyanide is a safer and easily handled reagent compared to hydrogen cyanide, sodium cyanide, or potassium cyanide.<sup>2</sup> Recently, one-pot procedures have also been developed for the synthesis of  $\alpha$ -aminonitriles from carbonyl compounds, amines and trimethylsilyl cyanide or tributyltin cyanide using lanthanide triflates as novel catalysts.<sup>3</sup> However, many of these methods involve the use of strongly acidic conditions and extended reaction times and also require tedious aqueous work-up leading to the generation of a large amount of toxic waste. Thus, there is still scope to develop a simple and practical method for the cyanation of imines under mild development of many cleaner chemical technologies. In particular, ionic liquids have recently gained recognition as possible environmentally safe and alternative solvents to conventional organic solvents. Ionic liquids, especially those based on the 1-*N*-alkyl-3-methylimidazolium cation have shown great promise as novel reaction media for various catalytic processes.<sup>5</sup>

In this work, a simple, convenient, and practical method for the synthesis of  $\alpha$ -aminonitriles **4** through a one-pot, three-component reaction of aromatic aldehydes **1** and amines **2** with trimethylsilyl cyanide (TMSCN) **3** in the presence of a catalytic amount of new and recoverable ionic liquid 1-butyl-3-methylimidazolium phthalimide-*N*-oxyl [BMIM][PINO] in EtOH at room temperature is described (Scheme 1).



**Scheme 1.** Synthesis  $\alpha$ -aminonitriles.

## 2. Experimental

### *Preparation of [BMIM][PINO]*

A mixture of *N*-hydroxyphthalimide (10 mmol), KOH (10 mmol) was refluxed in 100 ml of EtOH 96% for 2 hours. Then, the obtained potassium *N*-hydroxyphthalimide was filtered and dried in desiccator. After that, potassium *N*-hydroxyphthalimide was mixed with 1-butyl-3-methylimidazolium chloride in presence of 100 ml EtOH 96% refluxed for 3 hours. Finally, the reaction mixture was evaporated under reduced pressure to give the crude product [BMIM][PINO].

### *General procedure for the synthesis of $\alpha$ -aminonitriles 4*

A mixture of aldehyde (1 mmol), amine (1 mmol), and trimethylsilyl cyanide (1.2 mmol) in 1.5 ml EtOH 96% in presence of the [BMIM][PINO] was stirred at room temperature. After completion of the reaction, as indicated by TLC, the reaction mixture was washed with hot water (3×10ml) to give solid products.

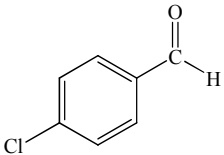
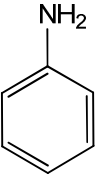
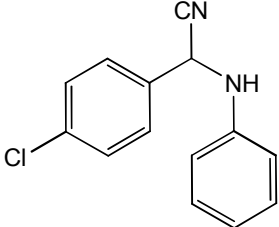
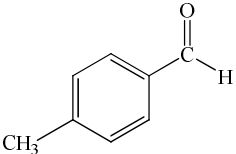
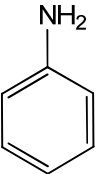
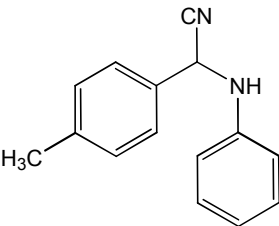
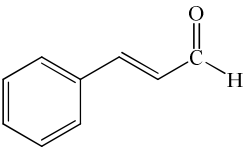
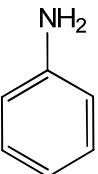
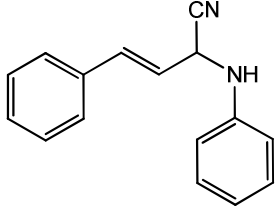
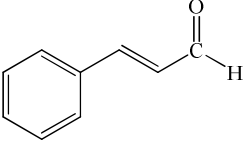
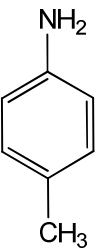
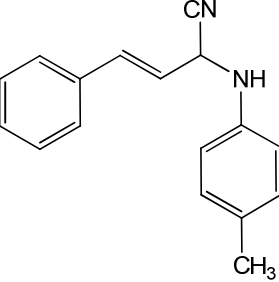
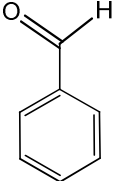
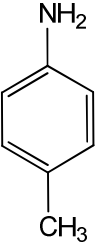
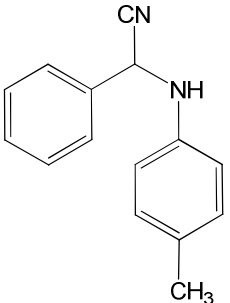
### 3. Results and Discussion

In a model reaction, the reaction of 4-chlorobenzaldehyde with aniline and trimethylsilyl cyanide (TMSCN) in the presence of a catalytic amount of [BMIM][PINO] in 1.5 ml EtOH 96% at room temperature was studied. The completion of the reaction was monitored by TLC. Then the reaction mixture was washed with hot water (3×10 ml). The crude product was crystallized from ethanol/water to give the pure product. A similar procedure was then used for various aromatic aldehydes and amines to afford the corresponding  $\alpha$ -aminonitriles in good to excellent yields at room temperature in ethanol as a green solvent (Table 1).

### 4. Conclusion

In summary, in this research an efficient, new and recoverable ionic liquid 1-butyl-3-methylimidazolium phthalimide-*N*-oxyl [BMIM][PINO] has been reported for the synthesis of  $\alpha$ -aminonitriles through a one-pot, three-component Strecker reaction using aromatic aldehydes, amines and trimethylsilyl cyanide under mild reaction conditions in EtOH. This reaction proceeds efficiently in the presence of a catalytic amount of [BMIM][PINO] at room temperature. In addition, the procedure offers several advantages, including mild reaction conditions, short reaction times, and simple experimental and isolation procedures, which makes it is a useful process for the synthesis of  $\alpha$ -aminonitriles.

**Table 1.** Synthesis  $\alpha$ -aminonitriles under the optimized reaction conditions

Entry	Aldehyde (1)	Amine (2)	Time (min)	Product (4)	Yiel <sup>a</sup> (%)	Mp (°C) (Lit.)
1			24		96	107-109 [109-112] <sup>4</sup>
2			10		97	78-80 [69-71] <sup>6</sup>
3			3		98	119-121 [117-119] <sup>4</sup>
4			2		95	106-108 <sup>4</sup>
5			1		85	107-109 [104-106] <sup>6</sup>

<sup>a</sup> Isolated yields.

## Acknowledgment

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