Spotlight

This feature focuses on a reagent chosen by a postgraduate, highlighting the uses and preparation of the reagent in current research.

New Uses for Indium(III) Chloride

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Introduction

Indium(III) chloride (InCl₃) is an inexpensive, commercially available, easy-to-handle, air- and water-stable Lewis acid with moderate toxicity. It shows a high tolerance to most functional groups including oxygen and nitrogen functionalities. Additionally, InCl₃ is very attractive for green-chemistry reactions due to its recyclability. Therefore, InCl₃ has been described as a catalyst for various reactions, especially multicomponent reactions (MCR), as given below.

Abstracts

(A) Synthesis of Furans:

Dey and co-workers reported a one-pot synthesis of polysubstituted furans (3) using but-2-ene-1,4-diones (1) and acetoacetates (2) under acid catalysis using InCl₃. It is an efficient and easy way of obtaining polysubstituted furans in excellent yields. In a similar manner, Suresh and co-workers reported a synthesis of various pyrroles from α-azido chalcones and 1,3-dicarbonyl compounds using acid catalysis with InCl₃ in water.

(B) Multicomponent Reaction:

A new protocol described a solvent-free, three-component reaction to generate 8,10-dimethyl-12-aryl-12H-naphtho[1′,2′:5,6]pyrano[2,3-d]pyrimidines (7) using functionalized aldehydes (4), 2-naphthol (5), and 6-amino-1,3-dimethyluracil (6) with InCl₃ as catalyst. The synthesis is conducted in the absence of a co-catalyst and the desired compounds were obtained in good yields and lower reaction times. Several other multicomponent reactions using InCl₃ have been described since then.

(C) Nucleophilic Substitution:

Lin and co-workers described a versatile and useful methodology for the synthesis of new C(sp³)–C(sp²), C(sp³)–N, C(sp³)–S and C(sp³)–O bonds via nucleophilic substitution of secondary alkyl-substituted propargyl acetates (8) in MeNO₂ using InCl₃. Over twenty substrates were tested and the substitution products were obtained in high yields.

(D) Barbier–Grignard-type Reaction:

A novel and efficient one-pot synthesis of propargylamines (11) via a Barbier–Grignard-type reaction was described for a variety of aldimines (9) and phenylacetylenes (10) in a bicatalytic system using InCl₃ and CuCl in water. The products were obtained in moderate to good yields, without formation of byproducts or hydrolysis of aldimines.
InCl₃ and Et₃SiH in methanol were able to promote the highly chemoselective reductive amination of various carbonyl compounds. In this methodology, ketones and aldehydes, some of them α,β-unsaturated, and various amines were used, including amines with other functional groups. The proposed mechanism suggests that the reducing agent is formed in situ by a catalytic cycle to generate active indium hydride species [InCl₃(MeOH)ₓ]⁺, which then transfers the hydride to an iminium ion intermediate to generate the corresponding amine.⁹

**References**

