Alkylation of Nitriles with Alcohols Catalyzed by a Well-Defined Cobalt Complex

Supported by a Tripodal N, P Mixed-Donor Ligand

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Abstract

The construction of a C-C bond is one of the central goals in both academia as well as industry. Among them, the alkylation of nitriles with alcohols is highly significant because nitrile products are the versatile structural motif for the construction of value-added products such as amides, carbonylic acids, ketones, and oxazolines. In addition, many drugs and natural products also contain nitriles group. There are many approaches for the alkylation of nitriles with alcohols; among them, transition metal catalyzed alkylation reaction is environmentally benign because it releases water as the sole byproduct. However, most of the catalysts for nitrile alkylation are based on noble metals such as Os, Rh, Ir, and Pd. These noble metals are not only expensive and rare but also toxic. So, it is desirable to develop a catalyst based on cheap, earth-abundant and less toxic transition metals. Recently, our group developed an air-stable catalyst based on cobalt metal which offers additional economic and ecological benefits than precious metals. This well-defined cobalt catalyst showed remarkable catalytic activities in ketone, ester, imine, and amine synthesis. Herein, we further explored its catalytic activities for the synthesis of nitrile products. We successfully synthesized nitrile products in good to excellent yields. The reaction releases water as the only byproduct and tolerates a wide variety of functional groups and heterocyclic moieties.

Drawbacks

- Mutagenic and toxic reagents
- Stoichiometric amount of base
- Potentional for dialkylated byproducts

Conclusion

In summary, the cobalt catalyst designed in our lab is a promising example of a homogenous earth-abundant metal catalyst. This catalyst showed excellent catalytic activity for the synthesis of value-added products such as ketone and esters. Herein, we further used our catalyst for the selective synthesis of α-alkylated nitrile product with water as the sole by-product.

Advantages of Alcohol as a Starting Material

- Can be obtained from the fermentation of cellulose
- On-toxic

Advantages of our catalyst

- Used earth abundant cobalt metal for catalysis
- Cheap
- Releases only water as a byproduct

Applications of α-Alkylated Nitriles Product

- Building blocks in organic synthesis
- Drugs such as Ruxolitinib, Vildagliptin, and Anastrozole contain nitrile group

References