Carbonyldiimidazole

2016-11-15

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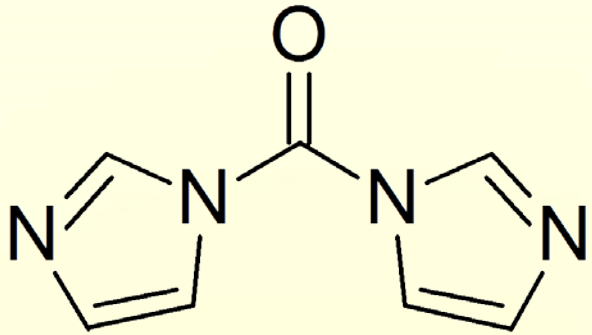
Carbonyldiimidazole



Physical Data: mp 116–118 ◦C. commercially available white solid.

Solubility: no quantitative data available. Inert solvents such as THF, benzene, CHCl3, DMF are commonly used for reactions.

Handling, Storage, and Precautions: moisture sensitive; reacts readily with water with evolution of carbon dioxide. May be kept for long periods either in a sealed tube or in a desiccator over P2O5

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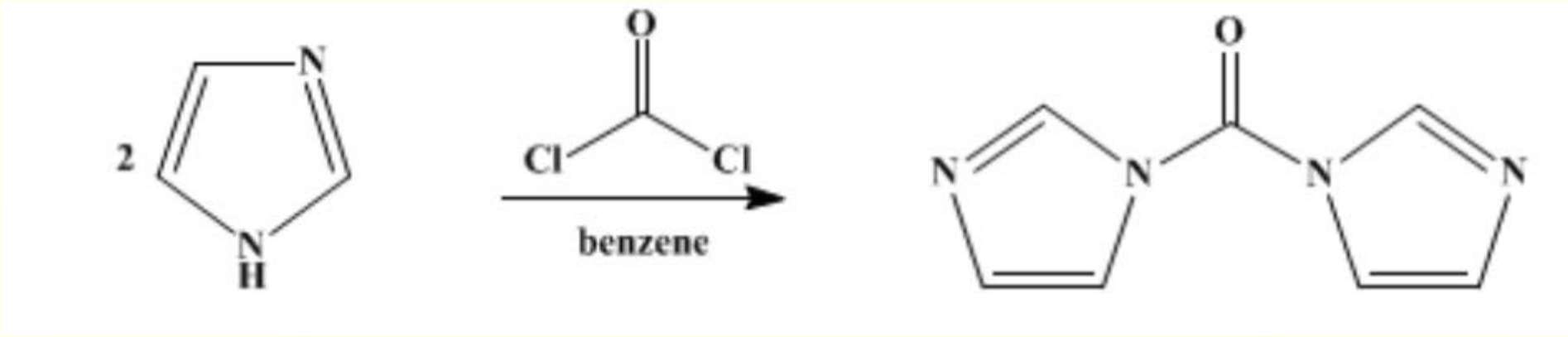

Preparative Method: prepared by mixing phosgene with four equivalents of imidazole in benzene/THF.

Analysis of Reagent Purity: purity can be determined by measuring the amount of CO2 evolved on hydrolysis.

Purification: may be purified by recrystallization from hot, anhydrous THF with careful exclusion of moisture.

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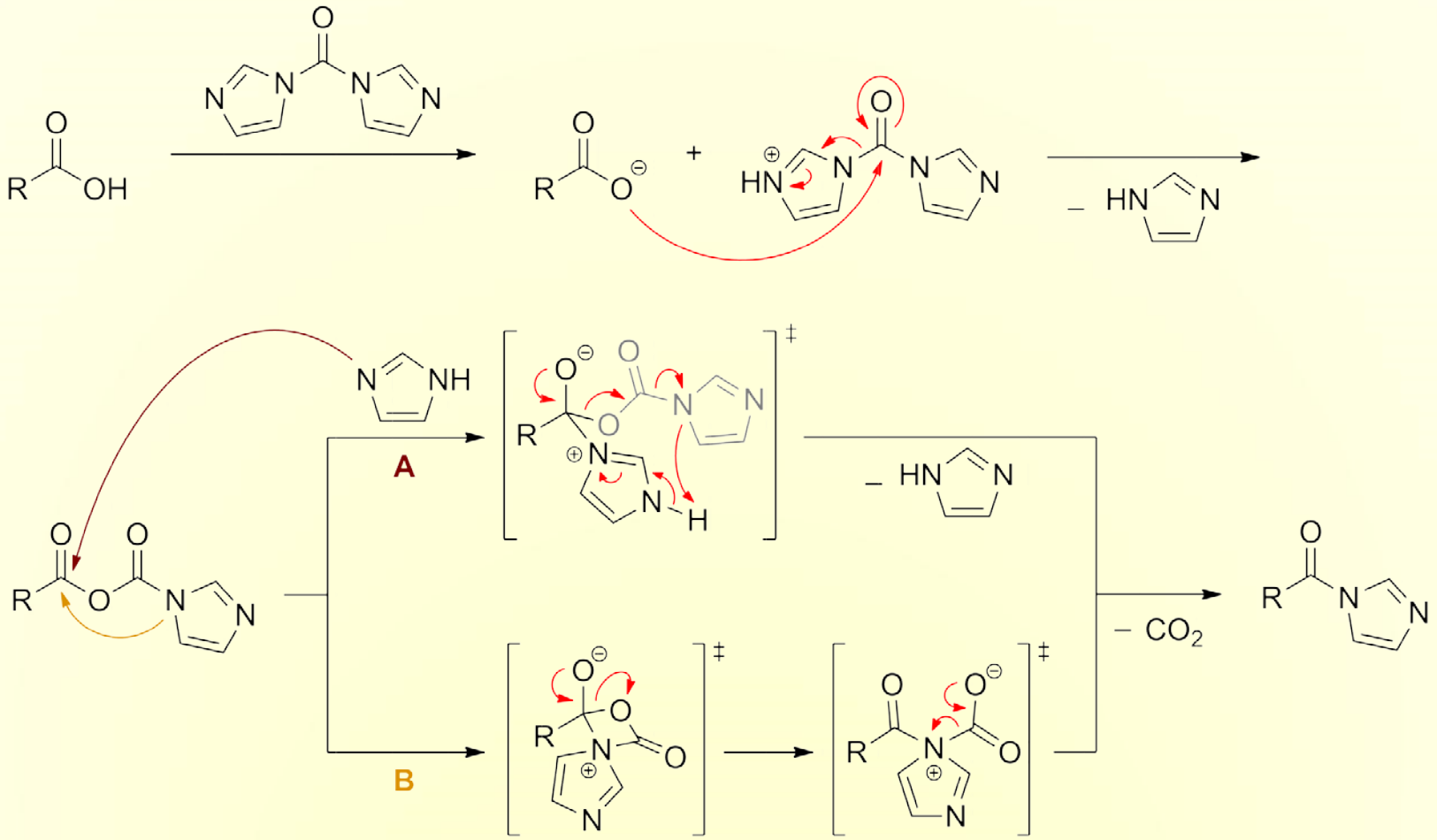
The proposed mechanism for the reaction between a carboxylic acid and CDI



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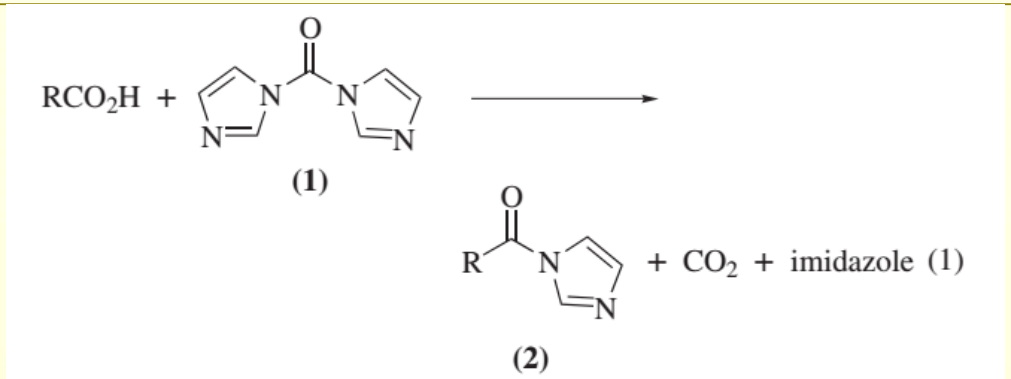

The method can be applied to a wide range of aliphatic, aromatic, and heterocyclic carboxylic acids, including some examples (such as formic acid and vitamin A acid) where acid chloride formation is difficult.

The reactivity of (**2**) is similar to that of acid chlorides, but the former have the advantage that they are generally crystalline and easily handled.

Isolation of (**2**) is simple, but often unnecessary; further reaction with nucleophiles is usually performed in the same reaction vessel.

(2) can be even conversed into acid chlorides (via reaction with HCl), hydrazides,**3** hydroxamic acids, and peroxy esters

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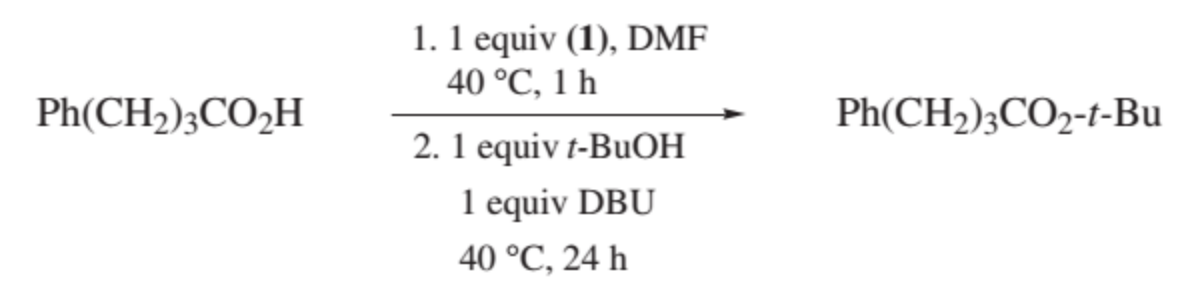
APPLACATIONS:

The use of stoichiometric ***1,8-Diazabicyclo[5.4.0]-undec-7-ene*** as base has been shown to provide good yields of*t*-butyl esters even for acids with acidic *α*-protons . This procedure was unsuccessful **for pivalic acid** or for ***N*-acyl-*α*-amino acids**.



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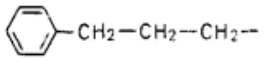
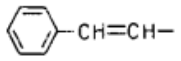
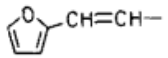
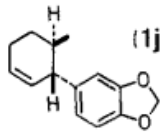
APPLACATIONS:

Table 1. *t*-Butyl Carboxylates **(3)** prepared

3	R	Reaction conditions [°C], [h]	Yield[a] [%]	b.p./torr[b] [°C]	n_D^{20}	Molecular formula or b.p./torr [°C] (Refractive Index) reported	High-Resolution M.S. *m/e* of M^+
a		40°, 5	91	128–130°/5	1.4911	94°/10[9] (n_D^{20}: 1.4908)[3]	
b	 (**3b**: Ref.[10])	40°, 24	85	135–140°/2	1.5052	131—132°/17[10] (n_D^{25}: 1.5024)[10]	
c		40°, 10	75	150–155°/2	1.4847	$C_{11}H_{14}O_3$ (220.14633)	220.14099
d		40°, 6	84	130–135°/2	1.4870	108°/8[11]	
e	n-C_6H_{13}	40°, 5	76	103–106°/2	1.4156	$C_{11}H_{22}O_2$ (186.16235)	186.16198
f	$H_3C-CH_2-CH_2-CH(CH_3)-$	40°, 24	85	104–105°/8	1.4066	60—61°/59[10] (n_D^{25}: 1.3986)[10]	
g		40°, 15	74	109–110°/5	1.4399 (n_D^{25}: 1.4378)	82.5–85.5°/9[12] (n_D^{25}: 1.4370)[12]	
h		40°, 24	64	150–155°/2	1.5385 (n_D^{16}: 1.5402)	160°/4[13] (n_D^{16}: 1.5414)[13]	
i		40°, 24	54	120–125°/2	1.5247	$C_{11}H_{14}O_3$ (194.09429)	194.09149
j	 (**1j**: Ref.[14])	80°, 5	68	168–172°/1	1.5248	$C_{18}H_{22}O_4$ (302.15181)	302.15616

[a] Yield of isolated product.
[b] Bath temperature of Kugelrohr vacuum distillation.

Ohta, S.; Shimabayashi, A.; Aono, M.; Okamoto, M., *Synthesis* **1982**, 833.

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APPLACATIONS:

An alternative approach to increasing the rate of esterification is to activate further the intermediate

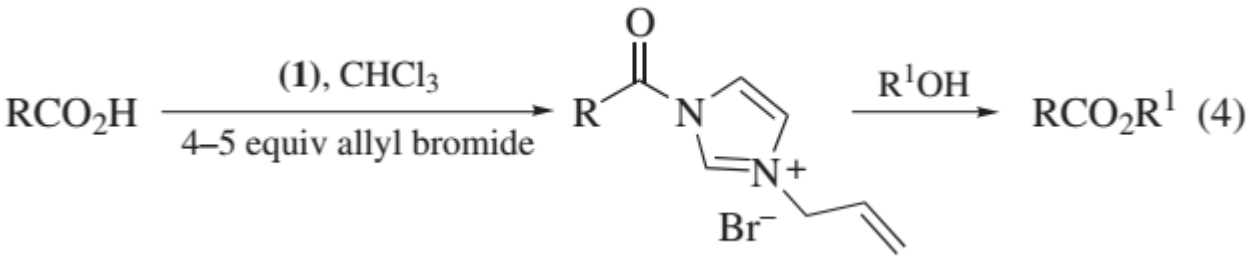
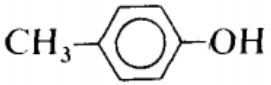


TABLE IV. Formylation of Alcohols and Phenols

ROH	Reaction[a] conditions	ROCHO Yield (%)
	r.t. 3 h	83
$PhCH_2CH_2OH$	r.t. 1 h	95
$Ph(CH_2)_2CHCH_3$ (OH)	r.t. 4 h	95

a) The reaction was carried out by method A using allyl bromide and an equimolar amount of formic acid.
r.t. = room temperature.

Chem. Pharm. Bull. 32(12)5044—5047(1984)

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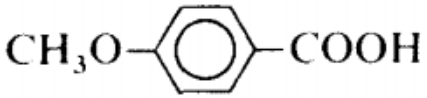
APPLACATIONS:

An alternative approach to increasing the rate of esterification is to activate further the intermediate

TABLE II. Esterification with *tert*-Butanol

RCOOH	Reaction[a] conditions	$RCOOC(CH_3)_3$ Yield (%)
	Reflux 3 h	80 (< 5)[b]
$PhCH=CHCOOH$	Reflux 3 h	80
$CH_3CH_2\underset{\displaystyle Ph}{\overset{\displaystyle |}{C}}HCOOH$	Reflux 10 h	95
$PhCH_2CH_2CH_2COOH$	Reflux 10 h	95 (< 5)[b]
$(CH_3)_3CCOOH$	Reflux 6 h	90

a) The reaction was carried out by method A using allyl bromide and an excess of *tert*-butanol.
b) The reaction was carried out in the absence of allyl bromide.

Chem. Pharm. Bull. 32(12)5044—5047(1984)

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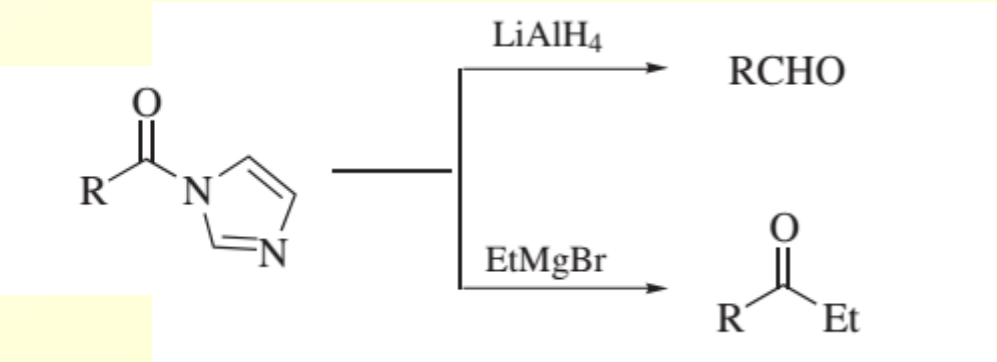
APPLACATIONS:

Aldehydes and Ketones from Carboxylic Acids. Reduction of the derived acylimidazole with ***Lithium Aluminum Hydride*** achieves conversion of an aliphatic or aromatic carboxylic acid to an aldehyde



Staab, H. A.; Lüking, M.; Dürr, F. H., *Chem. Ber.* **1962**, *95*, 1275 (*Chem. Abstr.* **1962**, *57*, 5908a).

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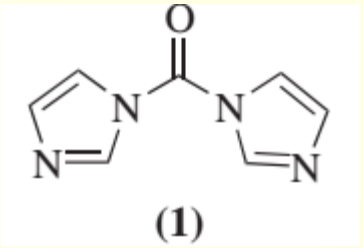
APPLACATIONS:

Ureas and Carbonates.



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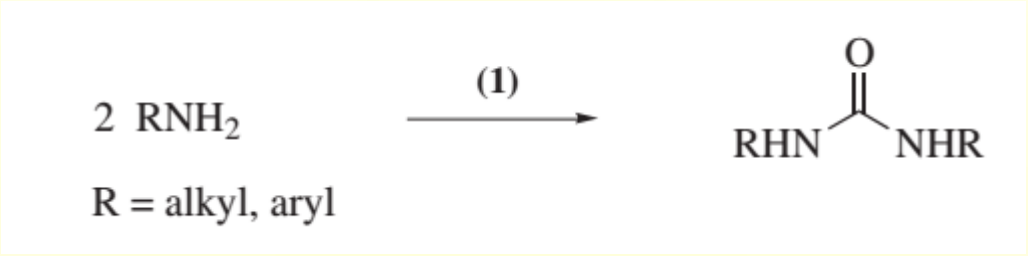

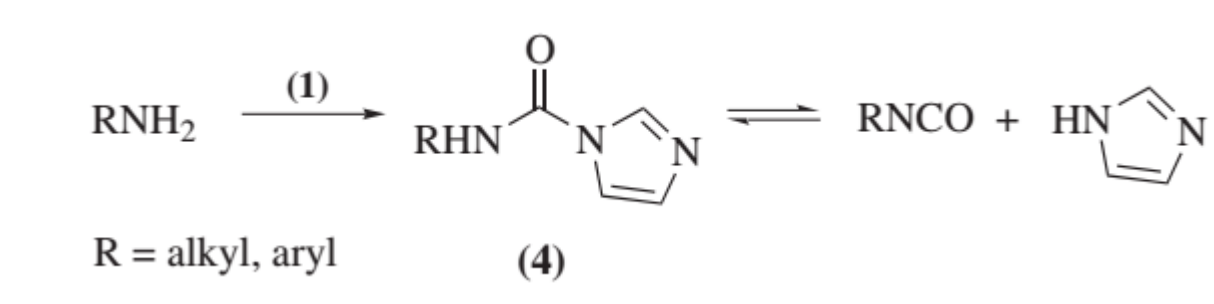

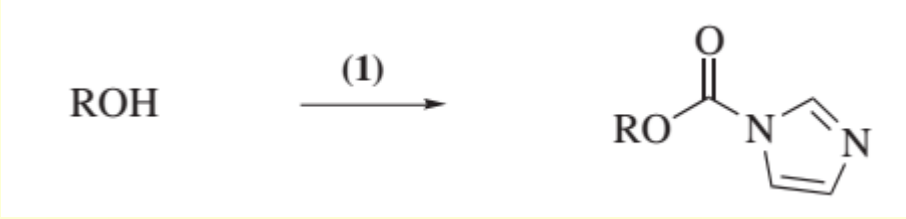

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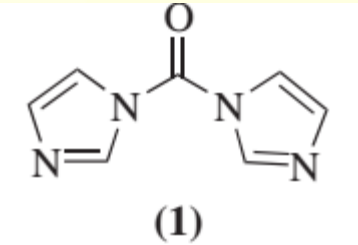
APPLACATIONS:

Halides from Alcohols.



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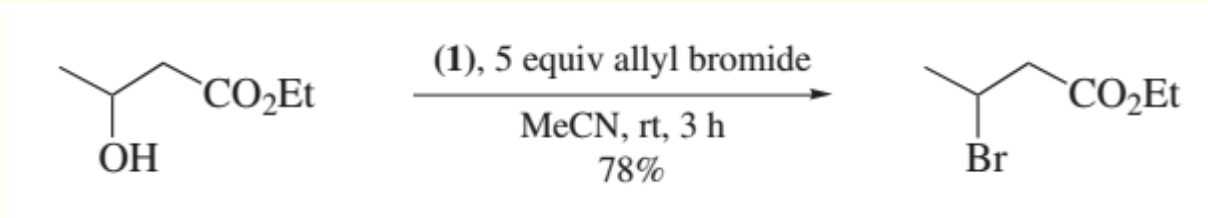

Any halide more reactive than the product halide may be used, but in practice **Allyl Bromide or *Iodomethane*** give best results as they are effective and readily removed after the reaction.

Acetonitrile is the best solvent and yields are generally high (>80%). Bromide or iodide formation work well, but not chlorination.

Optically active alcohols are racemized.

Kamijo, T.; Harada, H.; Iizuka, K., *Chem. Pharm. Bull.* **1983**, *31*,4189.

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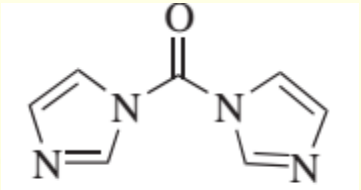
APPLACATIONS:

Glycosidation



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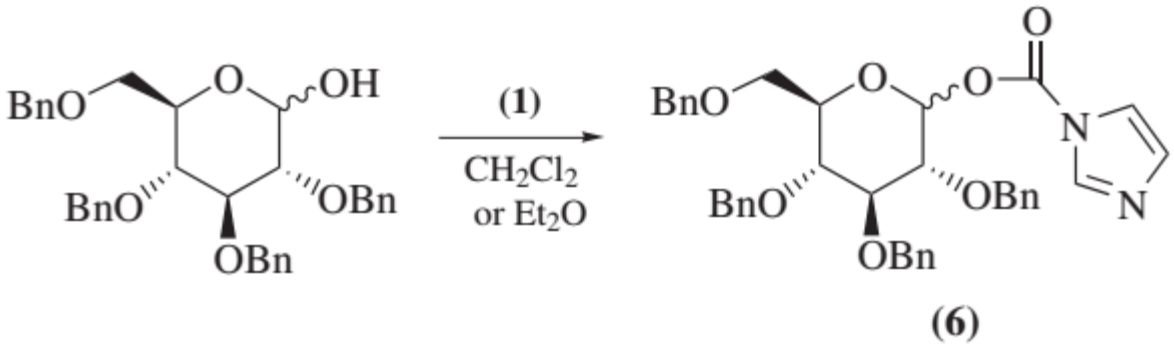
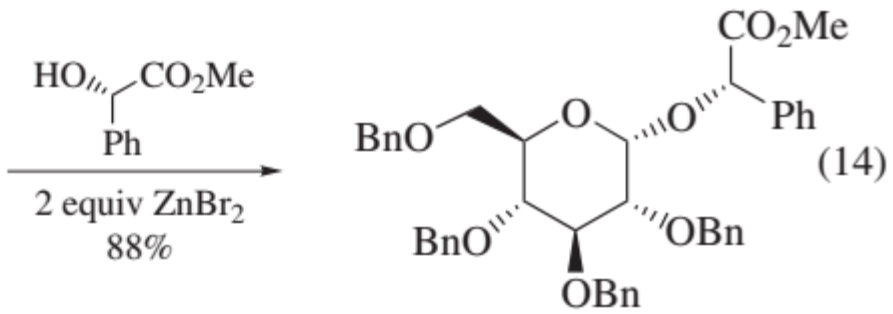


(6)



(14)

α:β = 10:1

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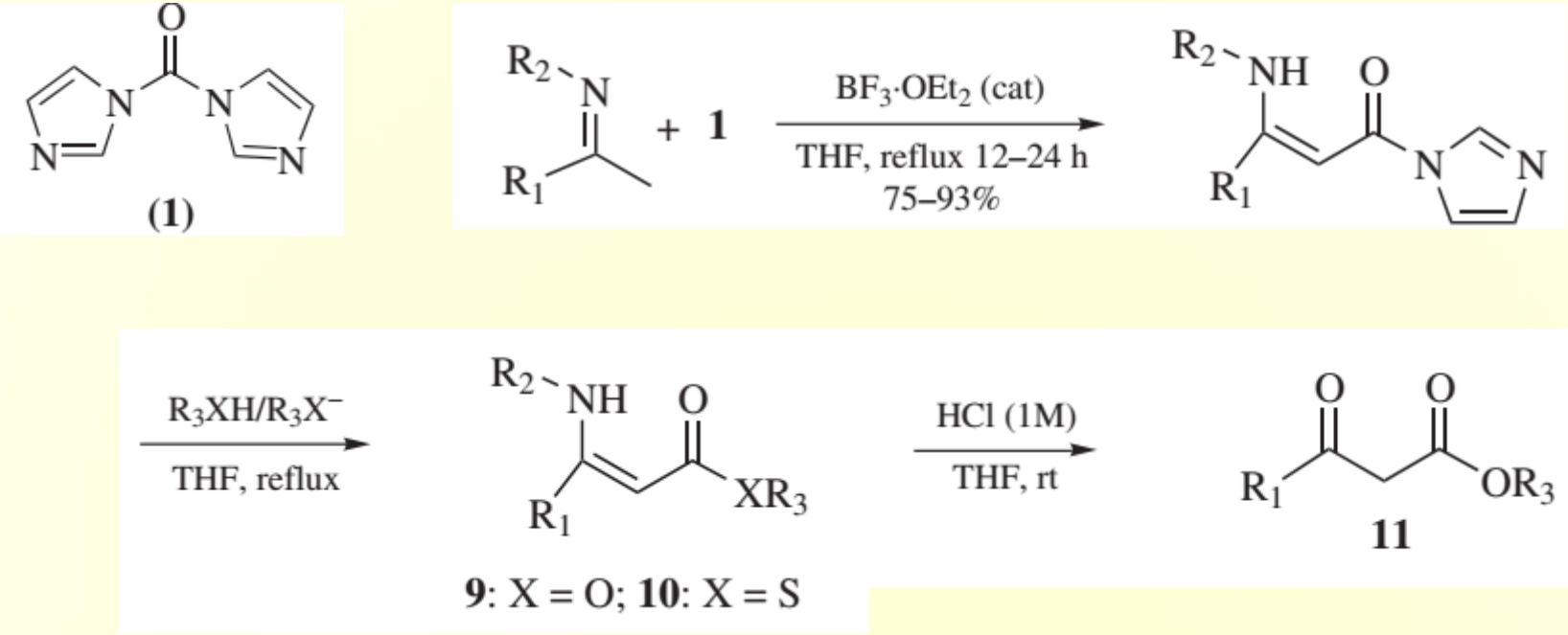
APPLACATIONS:

Preparation of *β*-Enamino Acid Derivatives.



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APPLACATIONS:

***N*-Formylimidazole**