

Reagents for pharmaceutical synthesis



AkzoNobel

Tomorrow's Answers Today



Welcome to AkzoNobel



AkzoNobel is proud to be one of the world's leading industrial companies.

In fact, we are the largest global paints and coatings company. As a major producer of specialty chemicals we supply industries worldwide with quality ingredients for life's essentials. We think about the future, but act in the present. We're passionate about introducing new ideas and developing sustainable answers for our customers.

We have operations in more than 80 countries, and employ around 55,000 people, who are committed to excellence and delivering **Tomorrow's Answers Today™**.

Our Functional Chemicals business makes organic peroxides, metal alkyls, organometallic specialties and polymer additives. We supply essential products used in polymer production and processing, as well as in chemical synthesis of small molecule drugs.

We have a long history in the manufacture and supply of metal alkyls and organic peroxides. Today, we're a global leader with a broad range of metal alkyls, including aluminum, magnesium, boron and zinc alkyls. And we're the world's top producer of organic peroxides.

We can help your production of intermediates and active pharmaceutical ingredients with our finest chemical reagents and specialty chemicals.

We also offer custom-manufactured organometallic compounds and specialty chemicals.

AkzoNobel: Looking beyond horizons

At AkzoNobel we look beyond horizons. We believe that what is good for you today is not necessarily good enough for you tomorrow. We are committed to the success of our customers. We offer you the technological answers you need.



The finest chemical reagents

In pharmaceutical synthesis, our products are especially useful in reduction, addition, alkylation, and deprotonation, where our reagents facilitate a wide range of asymmetric steps. Some of our products are presently used in the production of the world's leading blockbuster drugs.

We invite you to visit our website at www.akzonobel.com/polymer for complete product listings.

Our expertise and facilities find growing use in the synthesis of specialty chemicals that are used in the pharmaceutical and fine chemical industries.

We want to be your preferred supplier, producing custom specific products through arrangements protected by confidentiality agreements.

What do you need? From gram-scale to multiple-metric-ton level, we're happy to meet with you and discuss your target molecule.

AkzoNobel's key commercial chemical reagents and specialty chemicals for pharmaceutical synthesis

Organometallic Reagents

CAS no.	Acronym	Chemical name	Formula
1191-15-7	DIBAL-H	Diisobutylaluminum hydride	$(i\text{-C}_4\text{H}_9)_2\text{AlH}$
56252-56-3	DIBAL-BOT	Diisobutylaluminum butylated oxytoluene	$(i\text{-C}_4\text{H}_9)_2\text{AlO}(\text{C}_6\text{H}_4(\text{CH}_3)(t\text{-C}_4\text{H}_9)_2)$
75-24-1	TMAL	Trimethylaluminum	$(\text{CH}_3)_3\text{Al}$
97-93-8	TEAL	Triethylaluminum	$(\text{C}_2\text{H}_5)_3\text{Al}$
96-10-6	DEAC	Diethylaluminum chloride	$(\text{C}_2\text{H}_5)_2\text{AlCl}$
7397-46-8	DEB-M	Diethylboron methoxide or Diethylmethoxyborane or Methoxydiethylborane	$(\text{C}_2\text{H}_5)_2\text{BOCH}_3$
97-94-9	TEB	Triethylborane	$(\text{C}_2\text{H}_5)_3\text{B}$
557-20-0	DEZ	Diethylzinc	$(\text{C}_2\text{H}_5)_2\text{Zn}$
554-97-8	DMZ	Dimethylzinc	$(\text{CH}_3)_2\text{Zn}$
1191-47-5	DNBM	Di-n-butylmagnesium	$(n\text{-C}_4\text{H}_9)_2\text{Mg}$
62202-89-2	BEM	n-Butylethylmagnesium	$n\text{-C}_4\text{H}_9\text{MgC}_2\text{H}_5$
1271-19-8	TDC	Titanocene dichloride or Bis(cyclopentadienyl) titanium (IV) dichloride	$(\text{C}_5\text{H}_5)_2\text{TiCl}_2$

Peroxides and Initiators

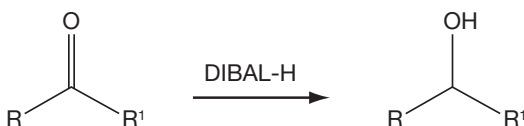
78-67-1	AIBN	2,2'-Azodi(isobutyronitrile)	$(\text{CH}_3)_2\text{C}(\text{CN})\text{N}=\text{NC}(\text{CH}_3)_2\text{CN}$
94-36-0	BPO	Dibenzoyl peroxide	$(\text{C}_6\text{H}_5\text{CO})_2\text{O}_2$
80-15-9	CHP	Cumyl hydroperoxide or Cumene hydroperoxide	$\text{C}_6\text{H}_5\text{C}(\text{CH}_3)_2\text{OOH}$
937-14-4	MCPBA	m-Chloroperoxybenzoic acid	$\text{ClC}_6\text{H}_4\text{CO}_3\text{H}$
75-91-2	TBHP	tert-Butyl hydroperoxide	$(\text{CH}_3)_3\text{COOH}$

Applications of our products in pharmaceutical synthesis

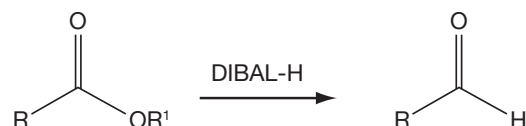
DIBAL-H Diisobutylaluminum hydride

Hydride Reduction

Hydride reduction, including epoxide to alcohol, enone to allylic alcohol, carboxylic acid to primary alcohol, lactone to cyclic alcohol, amide to aldehyde, amide to amine, and nitrile to aldehyde. For example:



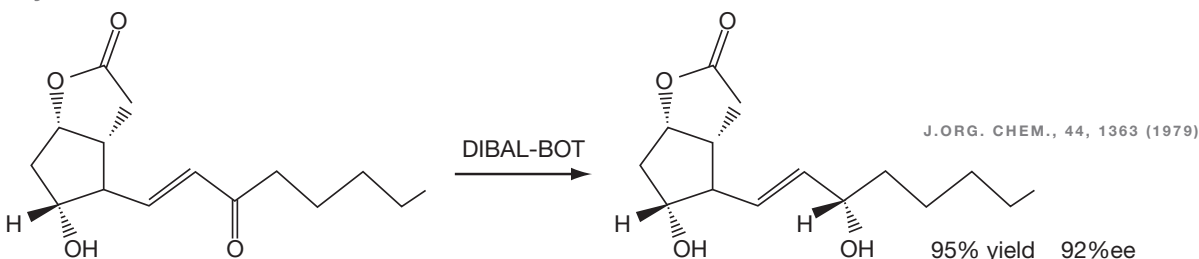
U.S. PATENT 5,086,185 (1992)



TETRAHEDRON LETT., 3, 619 (1962)

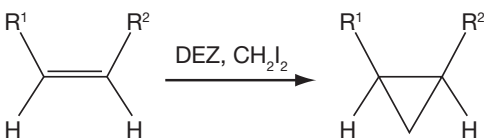
DIBAL-BOT Diisobutylaluminum butylated oxytoluene

Asymmetric Reduction



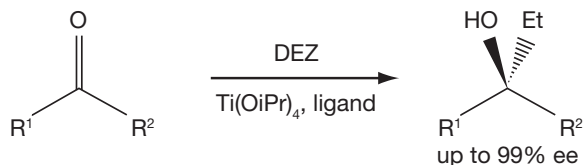
DEZ Diethylzinc

Cyclopropanation (Simmons-Smith)



MARCH'S ADVANCED ORGANIC CHEMISTRY, 5TH ED.
WILEY, NEW YORK (2001), P.1088

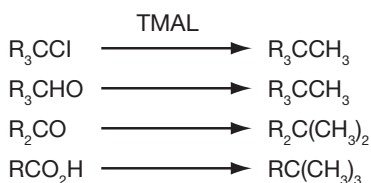
Asymmetric Addition



U.S. PATENT 6,660,884 B2 (2003)
J. AM. CHEM. SOC., 70, 448 (2005)

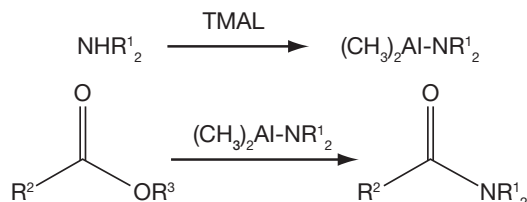
TMAL Trimethylaluminum

Alkylation

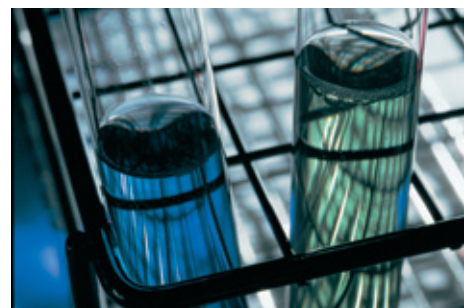


J. ORG. CHEM., 35, 532 (1970)
J. CHEM. SOC. CHEM. COMM., 595 (1972)

Weinreb Amidation

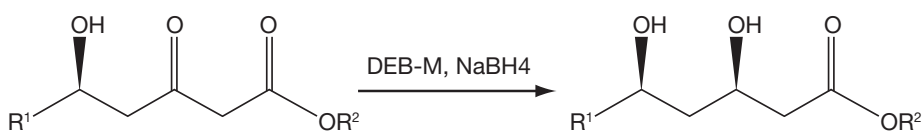


J. ORG. CHEM., 62, 6412 (1997)
ORG. SYN., 59 49 (1988)



DEB-M Diethylboron methoxide or Diethylmethoxyborane or Methoxydiethylborane

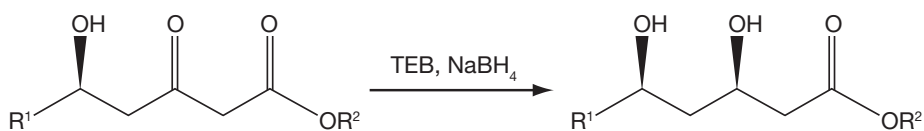
Asymmetric Reduction



TETRAHEDRON LETT., 28, 155 (1987)
U.S. PATENT 5,189,164 (1993)

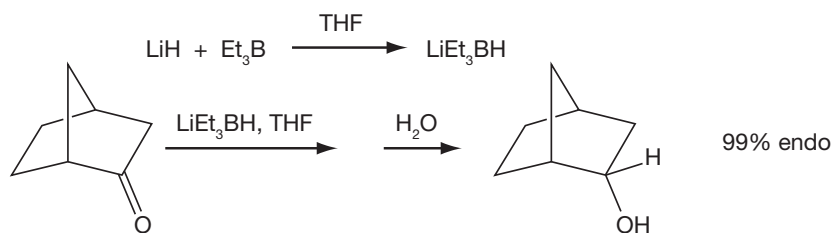
TEB Triethylborane

Asymmetric Reduction



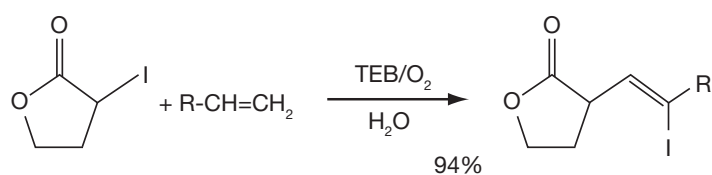
U.S. PATENT 4,681,893 (1987)
U.S. PATENT 5,273,995 (1993)

Asymmetric Reduction (via lithium triethylborohydride)



J. ORG. CHEM., 45, 1 (1980)

Free Radical Mediated Synthesis

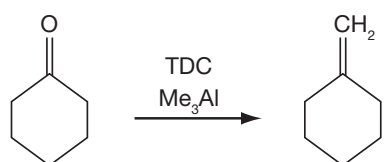


CHEM. REV., 101, 3415 (2001)



TDC Titanocene dichloride or Bis(cyclopentadienyl) titanium (IV) dichloride

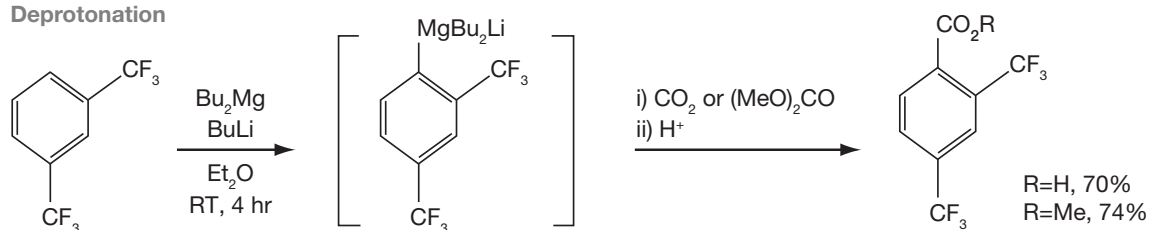
Tebbe Olefination



J. AM. CHEM. SOC., 100, 3611 (1978)

DNBM

Deprotonation



ANGEW. CHEM. INT. ED., 46, 2 (2007)

DEAC Diethylaluminum chloride

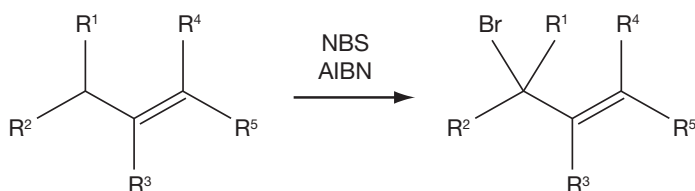
Diels Alder Reaction



SEE FOR EXAMPLE
J. AM. CHEM. SOC., 112, 3018 (1990)

AIBN 2,2'-Azodi(isobutyronitrile)

Radical Initiator



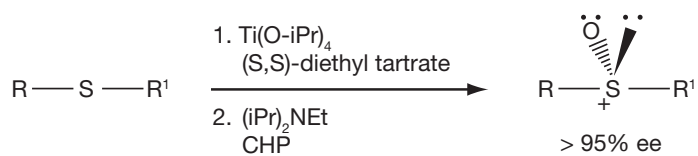
MARCH'S ADVANCED ORGANIC CHEMISTRY, 5TH ED.,
WILEY, NEW YORK (2001), P. 911



CHP

Cumyl hydroperoxide or Cumene hydroperoxide

Asymmetric Oxidation

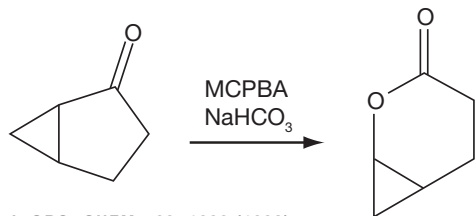


TETRAHEDRON ASYMMETRY, 11, 3819 (2000)

MCPBA

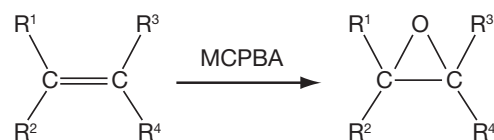
m-Chloroperoxybenzoic acid

Baeyer-Villiger Oxidation



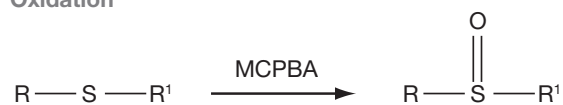
J. ORG. CHEM., 63, 1390 (1998)

Epoxidation



MARCH'S ADVANCED ORGANIC CHEMISTRY, 5TH ED., WILEY, NEW YORK (2001), P. 1051

Oxidation

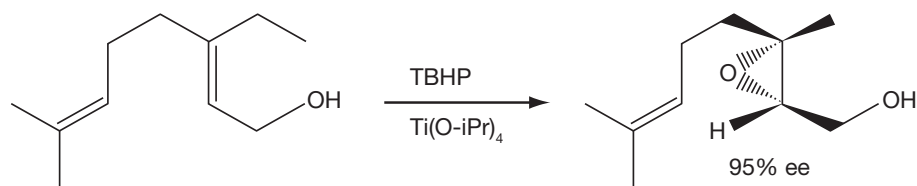


TETRAHEDRON ASYMMETRY, 11, 3819 (2000)

TBHP

tert-Butyl hydroperoxide

Asymmetric Epoxidation (Sharpless)



J. AM. CHEM. SOC., 102, 5974 (1980)

Logistics and technical support

AkzoNobel operates manufacturing facilities for organometallic reagents and organic peroxides in the Americas, Europe, and Asia. Our versatile facilities and flexible production schedules enable us to supply your favorite products from a few grams to multiple tons, and anything in between. Our global distribution network allows us to deliver the products to you anywhere in the world.

Security of Supply

We at AkzoNobel always place safety as our top priority in customer service. Our Safety Research laboratory in Deventer, the Netherlands, conducts routine safety tests on our products and develops protocols for your safe handling. Our safety programs combine classroom learning and live demonstrations with on-site consulting, to assist you in receiving and using our products. We also offer design and maintenance services at your sites to support your handling and storage of hazardous materials.

All production sites are ISO 9001 and ISO 14001 certified in order to ensure the highest product quality and strictest compliance with environmental regulations. Additionally, our sites in the Americas have achieved RC 14001 certification.



- Regional headquarters
- Manufacturing sites
- R&D sites



AkzoNobel is consistently ranked as one of the Chemicals industry leaders on the Dow Jones Sustainability World Indexes (DJSI), showing that we take our obligations seriously - to the planet, to our customers, to our own people. We believe the only way to grow is by developing sustainable, innovative solutions that benefit our customers. And we're constantly looking for ways to reduce our impact on the environment.

We're committed to Responsible Care®, Product Stewardship and REACH.

For product inquiry and ordering information, please contact your AkzoNobel account manager or regional AkzoNobel sales office.

Americas

for Mexico

Akzo Nobel Chemicals, S.A. de C.V.
Av. Morelos No. 49
Col. Tecamachalco
Los Reyes La Paz Estado de Mexico
C.P. 56500 Mexico
T +52 55 5858 0700
F +52 55 5858 0703
E polymerchemicals.mx@akzonobel.com

for Brazil

Akzo Nobel Ltda.
Rodavia Akzo Nobel no. 707
Portão A – Planta C
Bairro São Roque da Chave
13295-000 Itupeva - São Paulo
Brazil
T +55 11 4591 8800
F +55 11 4591 2516
E polymerchemicals-sa@akzonobel.com

for other countries

AkzoNobel Functional Chemicals
525 West Van Buren Street
Chicago, IL 60607
US
T +1 800 828 7929 (US only)
T +1 312 544 7000
F +1 312 544 7188
E polymerchemicals.na@akzonobel.com

Europe, Middle East and Africa

for France, Italy, Spain and Portugal

Akzo Nobel Chemicals, S.A.
Autovia de Castelldefels, km 4.65
08820 El Prat de Llobregat
Barcelona
Spain
T +34 93 4784411
F +34 93 4780734
E polymerchemicals.es@akzonobel.com

for Russia and CIS

OOO AkzoNobel
Akzo Nobel N.V., Representative Office
Smolnaya Str., 24D,
Commercial Tower Meridian
125445 Moscow
Russia
T +7 495 9602890
F +7 495 9602884
E info.moscow@akzonobel.com

for Middle East

AkzoNobel
P.O. Box 290
Al Quouz Industrial Area
Sheikh Zayed Hwy.
Dubai
United Arab Emirates
T +971 3472491
F +971 3472339
E polymerchemicals.nl@akzonobel.com

for other countries

AkzoNobel Functional Chemicals
Stationsstraat 77
3811 MH Amersfoort
P.O. Box 247
3800 AE Amersfoort
The Netherlands
T +31 33 467 6677
F +31 33 467 6116
E polymerchemicals.nl@akzonobel.com

Asia Pacific

Akzo Nobel (Asia) Co., Ltd.
The Exchange, 5th floor
299 Tong Ren Road
Shanghai 200040
P.R. China
T +86 21 2216 3600
F +86 21 3360 7739
E polymerchemicals.ap@akzonobel.com

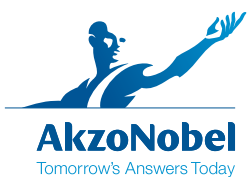
for India

Akzo Nobel Chemicals (India) Ltd.
Tellus Building, 2nd floor
209/1B/1A Range Hills
Pune 411020
Maharashtra
India
T +91 20 2556 0384/85/86
F +91 20 2556 0390
E sales.ancil@akzonobel.com

Additional information

Product Data Sheets (PDS) and Material Safety Data Sheets (MSDS) are available at www.akzonobel.com/polymer

All information concerning these products and/or all suggestions for handling and use contained herein are offered in good faith and believed to be reliable. AkzoNobel Functional Chemicals and its affiliates, however, make no warranty as to the accuracy and/or sufficiency of such information and/or suggestions, as to the products' merchantability or fitness for any particular purpose, or that any suggested use will not infringe any patent. Nothing contained herein shall be construed as granting or extending any license under any patent. Buyer must determine for himself, by preliminary tests or otherwise, the suitability of these products for his purposes. The information contained herein supersedes all previously issued bulletins on the subject matter covered. The user may forward, distribute and/or photocopy this document only if unaltered and complete, including all of its headers and footers, and should refrain from any unauthorized use. You may not copy this document to a website.



www.akzonobel.com/polymer

AkzoNobel is the largest global paints and coatings company and a major producer of specialty chemicals. We supply industries and consumers worldwide with innovative products and are passionate about developing sustainable answers for our customers. Our portfolio includes well known brands such as Magala, Perkadox, Trigonox, Sikkens and Eka. Headquartered in Amsterdam, the Netherlands, we are a Global Fortune 500 company and are consistently ranked as one of the leaders on the Dow Jones Sustainability Indexes. With operations in more than 80 countries, our 55,000 people around the world are committed to excellence and delivering Tomorrow's Answers Today™.

© 2011 AkzoNobel Functional Chemicals,
all rights reserved

"Tomorrow's Answers Today" is a trademark of Akzo Nobel N.V.