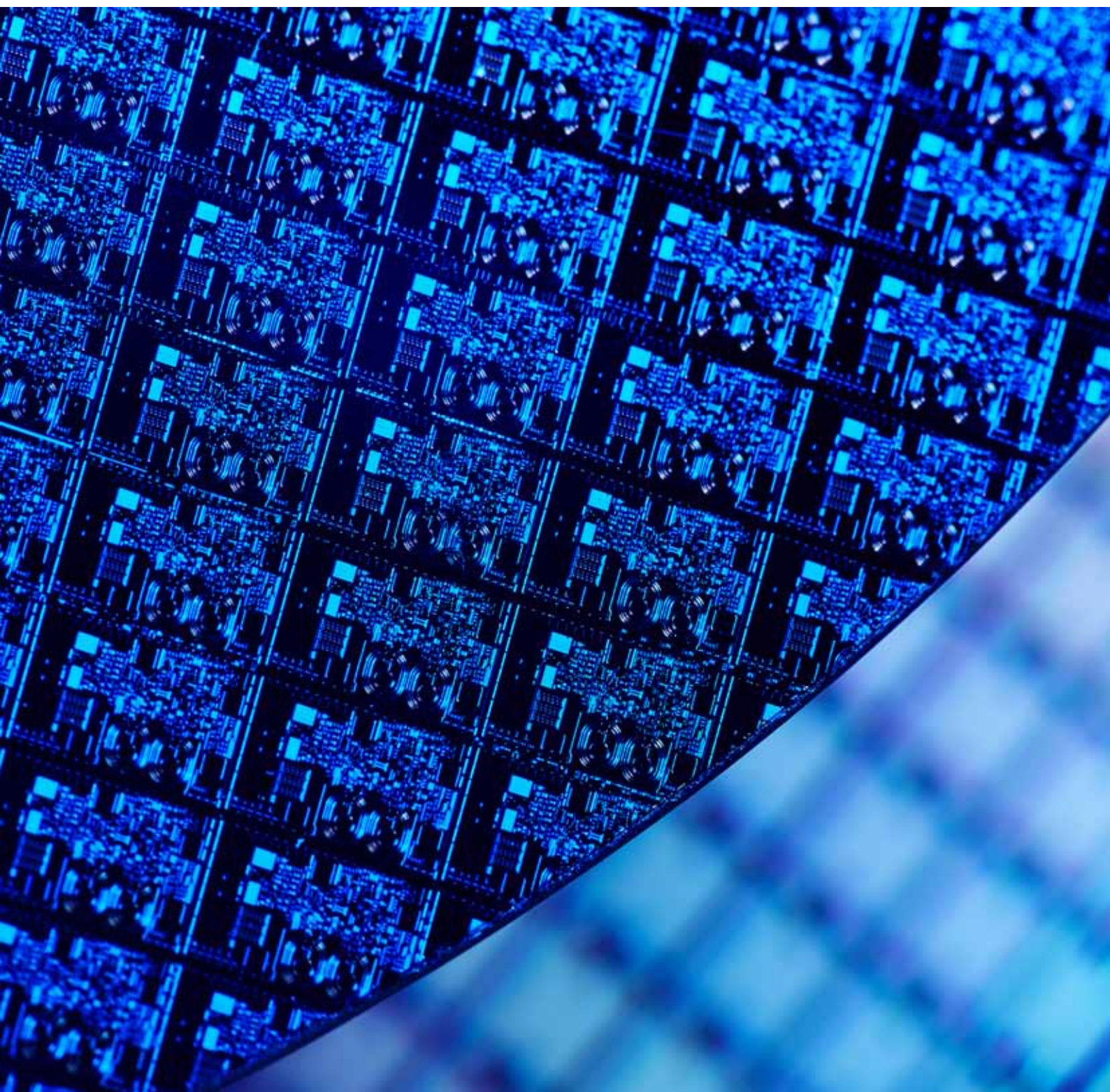


High Purity Metalorganics

AkzoNobel



High purity metalorganics

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

AkzoNobel is a leading global paints and coatings company and a major producer of specialty chemicals. Calling on centuries of expertise, we supply industries and consumers worldwide with innovative products and sustainable technologies designed to meet the growing demands of our fast-changing planet. We're passionate about introducing new ideas and developing sustainable answers for our customers.

With operations in more than 80 countries, our 47,000 people around the world are committed to delivering leading products and technologies to meet the growing demands of our fast-changing world.

Our High Purity Metalorganics business (HPMO) is one of the globally leading companies that serve the electronics industry with high purity MO-sources, which are used in a variety of deposition processes.

A long history

We have a long history in metal alkyls, starting with large scale production of aluminum alkyls in 1959. Today we are one of the leading global producers of these products with a broad range of metal organics based on aluminum, zinc, magnesium, gallium, indium and boron, which are supplied to the polymer, pharmaceutical and semiconductor industry.

MO-Sources

AkzoNobel High Purity Metalorganics division was created in 2000 in order to better serve the semiconductor industry.

This allows us to focus on the specific needs of this market while leveraging our global distribution and service networks, manufacturing scale and expertise, global R&D, and expertise in safe handling of metalorganics. As such, we excel in safety, quality, consistency and innovation.

We focus on the production of high purity MO-sources based on indium, gallium, aluminum, zinc and magnesium. These products have >99.999% purity and are sold in electropolished stainless steel bubblers to the semiconductor industry. We have grown over the past decade to become one of the leading suppliers of these chemicals. Our products are used in a huge range of industrial and consumer products. These include LED lighting, solar cells, lasers and many other electronic devices.

World-scale production and backward integration

Our La Porte, Texas manufacturing site was the first to produce trimethyl gallium in 1971, and has since then been expanded significantly to produce a wide range of MO-sources in dedicated production equipment. Owing to our vast knowledge of the safe and efficient production of metalorganics for the polymer industry, we produce our high purity MO-sources at relatively large scale, ensuring high purity and excellent product consistency.

We also operate a world-scale trimethyl aluminum (TMAI) plant, making us the only high purity metalorganics producer fully back-integrated into this important raw material. We use leading edge transfilling techniques that ensure the repeatable and consistent delivery of the highest purity metalorganics in every cylinder that we supply.

Our La Porte site is an OSHA VPP Star site, and is ISO 9001 and 14001 certified, recognizing strict compliance with environmental regulations and adherence to state-of-the-art quality systems.

Our products are distributed globally using regional transfilling and/or warehousing distribution centers, ensuring close proximity to our customers.

Innovation

At AkzoNobel we look beyond horizons. We believe what is good for you today is not necessarily good for you tomorrow.

We are committed to support the continued steep growth of the industries we serve by supplying the growing volumes of MO-sources required, building on the advantages of integration in our overall large-scale metalorganics production environment.

We also continue offering innovations in bubbler design providing enhanced and stable delivery of our products, and offer various larger bubbler types meeting the growing volume demand of our customers. As a next step, we support the development of central delivery systems, building on our experience in the supply of bulk high purity metalorganics to the solar cell industry.

Our Products

Our range of products to the compound semiconductor and Si-semiconductor industry includes ultra-high purity gallium-, indium-, aluminum-, magnesium- and zinc-based MO-sources.

Element	Chemical name	Acronym
Aluminum	Trimethylaluminum Low Ox – Trimethylaluminum Triethylaluminum	TMAI TMAI LO TEAI
Gallium	Trimethylgallium Triethylgallium	TMGa TEGa
Indium	Trimethylindium	TMIIn
Magnesium	Bis(cyclopentadienyl)magnesium	Cp2Mg
Zinc	Dimethylzinc Diethylzinc	DMZn DEZn

Cylinder and Equipment Offerings

AkzoNobel Metalorganic cylinders are designed and manufactured to the highest standards in industrial semiconductor manufacturing technologies:

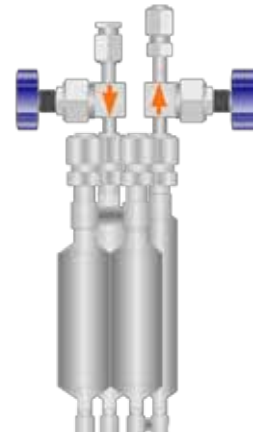
- Semiconductor industry compatible cleaning, regeneration and handling
- Interior surface is electro-polished
- Constant and consistent wall thickness which leads to defined thermal transfer
- Optional purging valve configurations

For delivery of TMIIn we have developed the Hiperquad bubblers, which offer the following benefits:

- Unique stability of the TMIIn flow-rate and MO-concentration during the entire lifetime of the bubbler
- Complete utilization of the TMIIn source up to 98%

Dimensions

Type	Max. width (mm)	Max. depth (mm)	Fitting height (mm)	Fill height (mm)	Fill weight TMIIn (gr)
Hiperquad 350	89	87	300	152	350
Hiperquad 850	130	120	330	195	850



Heat exchangers and innovative thermostats

Enabling customers to minimize downtime, we also offer convenient custom-designed heat-exchangers that can be connected to traditional water baths, for several of our larger fill size bubblers.

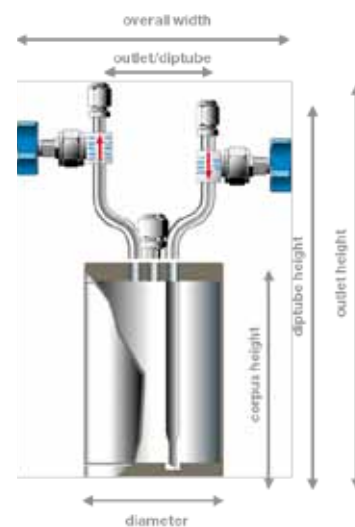
Our Cylinders

A variety of cylinder sizes with a range of volumes is available.

The tables below provide detailed cylinder dimensions and typical fill weight data for liquid MO-sources. More cylinder styles and sizes as well as other valve configurations are available on request.

Cylinder volumes and dimensions

Cylinder	Gross volume ¹ (ml)	Corpus height (mm)	Diameter (mm)	Diptube height (mm)	Outlet height (mm)	Diptube outlet (mm)	Overall width (mm)
150 ml	150	108	51	235	248	83	219
400 ml	350	108	76	235	248	83	219
600 ml	540	164	76	291	303	83	219
1000 ml	980	168	102	295	308	83	219
3000 ml	2590	191	152	318	331	83	219
3800 ml	3800	195	168	335	348	83	219
8000 ml (8 L)	6400	400	168	514	527	83	220
20000 ml (20 L)	18250	403	273	511	524	83	319



Standard fill weights (gram)²

Cylinder	TMGa	TEGa	TMIn	TMAI	DMZn	DEZn	Cp2Mg
150 ml	150	150	100	100	150	150	50
400 ml	350	350	250	230	400	400	100
600 ml	600	550	400	380	700	600	-
1000 ml	1000	1000	-	730	1100	1000	-
3000 ml	2900	2700	-	1900	3500	3000	-
3800 ml	3800	3600	-	2500	4700	4000	-
8000 ml (8 L)	7200	6600	-	4700	-	-	-
20000 ml (20 L)	20000	19000	-	-	-	-	-

¹ Gross volume is defined as the maximum filling volume, 90% of total cylinder volume.

² Fill weights based on maximum fill volume; smaller fill weights are available on request.



Your safety Our priority

AkzoNobel's success in safely handling Metal Organics (MO) is due to our long-term commitment to safety. Knowledge of proper handling techniques, carefully designed facilities and thorough training of personnel can overcome the hazards. Personnel who understand and pay proper attention will be able to handle metal organics confidently and safely.

Safety and Handling

Our MO-sources like TMAI, TMGa and TMIh ignites upon exposure to air and reacts violently with water. They must be handled under a dry, inert atmosphere, e.g. nitrogen or argon. TMAI may undergo exothermic decomposition with evolution of flammable gas if heated above 120°C (248°F). The decomposition may become self-accelerating and UNCONTROLLABLE and may result in an explosion. Water must be scrupulously removed from process equipment prior to putting it into metal alkyls service. Failure to do so may result in an explosion. MO-sources causes severe burns to the skin and eyes. It is imperative that proper personal protective equipment be worn when handling MO's.

Storage

MO sources are stable when stored under a dry, inert atmosphere and away from heat. MO's may undergo violent exothermic decomposition with flammable gas evolution if stored at too high temperatures.

Metal alkyls should, in general, be kept 6-12°C above their melting point. For example, in case of solidified TMAI (melting point 15°C) place the container for at least 16 hours in a temperature controlled room at 25-35°C until the product is completely liquified.

Safety Services

AkzoNobel is recognized as a global leader in metal alkyl safety. We always place safety as our top priority. Sharing our experience in safety is one of the most important resources we offer. Through our safety programs we can provide expert advice on the handling of these materials including:

- classroom review of safety and handling of metal alkyls
- consultation of metal alkyl facility design
- demonstrations on the safe use, handling and control of metal alkyls
- demonstrations on the safe connecting and disconnecting of cylinders
- on-site assistance and advice regarding procedures



Contact us

Your global AkzoNobel HPMO team is here to serve you. For more information, please contact your sales manager or regional AkzoNobel sales office.

Americas

AkzoNobel Polymer Chemistry
525 West Van Buren Street
Chicago, IL 60607
US
T +1 978 317 3280
E metalorganicsNA@akzonobel.com

Europe, Middle East and Africa

AkzoNobel Polymer Chemistry
Velperweg 76
6824 BM Arnhem
P.O. Box 9300
6800 SB Arnhem
The Netherlands
T +31 88 969 2727
E metalorganicsEU@akzonobel.com

Asia Pacific

Akzo Nobel (Asia) Co., Ltd.
22F, Eco City, 1788 West Nan Jing Road
Shanghai 200040
P.R. China
T +86 21 22205649
M +86 18516145050
E metalorganicsAP@akzonobel.com

Additional information

Product Data Sheets (PDS) and Safety Data Sheets (SDS) are available at www.akzonobel.com/hpmo

On request we also provide specific publications on subjects such as the safe use and storage of metal alkyls, facilities design and maintenance, and unloading procedures.



www.akzonobel.com/hpmo

AkzoNobel creates everyday essentials to make people's lives more liveable and inspiring. As a leading global paints and coatings company and a major producer of specialty chemicals, we supply essential ingredients, essential protection and essential color to industries and consumers worldwide. Backed by a pioneering heritage, our innovative products and sustainable technologies are designed to meet the growing demands of our fast-changing planet, while making life easier. Headquartered in Amsterdam, the Netherlands, we have approximately 45,000 people in around 80 countries, while our portfolio includes well-known brands such as Dulux, Sikkens, International, Interpon and Eka. Consistently ranked as a leader in sustainability, we are dedicated to energizing cities and communities while creating a protected, colorful world where life is improved by what we do.

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