

Metalloenes

High purity and thermal stability make them versatile as ALD precursors for deposition applications

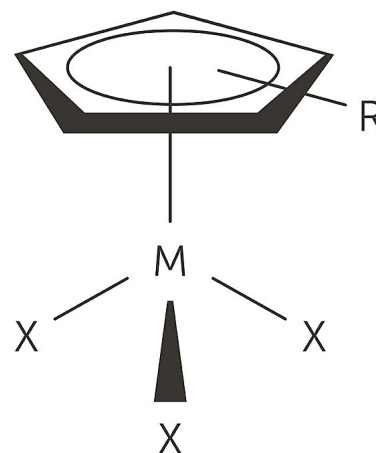
As a leader in specialty chemicals and advanced materials for the microelectronics, life sciences, and other high-tech industries, we can accelerate your new product development efforts and manufacturing supply chain by providing critical materials at the appropriate scale, and within the communicated delivery schedule. Our metallocenes are tailored to your manufacturing requirements and specifications to meet your high-quality customized needs.

Organometallics bearing the cyclopentadienyl (Cp) ligand have been instrumental in the design and development of atomic layer deposition (ALD) precursors that require high thermal stability of the molecule relative to other organometallic precursors. Our state-of-the-art Cp cracking capabilities enable synthesis of a wide range of metallocene-based organometallics.

Our experienced R&D teams provide deep chemistry expertise in an innovative culture to deliver custom synthesis solutions that meet your proprietary development needs. With our extensive manufacturing capabilities, we can handle a range of projects from grams to metric ton quantities, through scale-up and full commercialization. We also provide chemical process development, piloting, and custom chemical manufacturing.

APPLICATIONS

- ALD precursors for semiconductor deposition
- High aspect ratio (HAR) ALD
- Higher temperature ALD processes



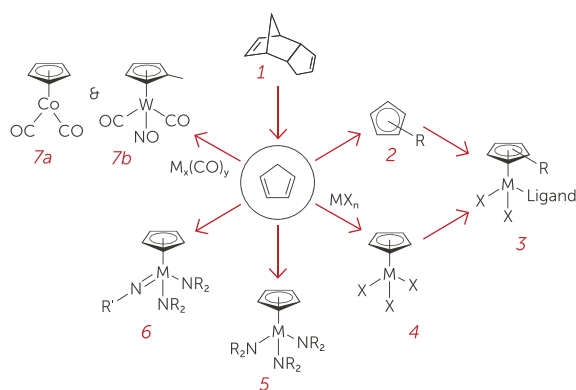
FEATURES & BENEFITS

State-of-the-art Cp cracking and distillation capabilities	Enable synthesis of a wide range of metallocene-based organometallics
High purity and thermal stability properties	Provide versatility as ALD precursors for semiconductor deposition applications that require higher temperatures
Advanced scientific expertise and over 20 years of Cp chemistry experience	Technical transfers, R&D, scale-up optimization, and continuous improvement are conducted by PhD chemist-led teams that are supported by world-class quality and analytical resources
ISO 9001 certification	The Entegris quality management system (QMS) certified by the ISO 9001 standard ensures provision of consistent quality products meeting customer regulatory requirements

SPECIFICATIONS

Product	Pentamethylcyclopentadienyl titanium trichloride, Cp*TiCl ₃	
Appearance	Red crystalline powder	
NMR purity	>99.0%	
Trace metals	Aluminum	<20 ppm
	Chromium	<10 ppm
	Copper	<50 ppm
	Iron	<20 ppm
	Magnesium	<10 ppm
	Nickel	<10 ppm
	Zinc	<10 ppm

DRAWINGS



Capabilities

Our state-of-the-art system for cracking dicyclopentadiene (**1**) allows access to the synthesis of a wide range of metallocene-based organometallics. The parent cyclopentadiene can be effectively derivatized to several alkyl-substituted cyclopentadienyl ligands (**2**), which allows for extensive customization of metallocene precursors. For example, MeCp and iPrCp can be readily prepared and attached to a preformed organometallic complex to yield products with motifs such as **3** (see graphic).

The cyclopentadienyl ligand can also be attached to metal halides, metal amides, and metal imides to yield products such as **4**, **5**, and **6** (see graphic). We also supply a full range of metal amides and imides to complement this chemistry and capability.

Metal carbonyls bearing Cp ligands **7a** and **7b** (see graphic) can also be accessed through reactions involving their parent metal carbonyls. Our commitment to safety ensures the safe handling of all raw materials and finished goods that have the propensity to lose carbon monoxide.

FOR MORE INFORMATION

Please call your Regional Customer Service Center today to learn what Entegris can do for you. Visit [entegris.com](https://www.entegris.com) and select the [Contact Us](#) link to find the customer service center nearest you.

TERMS AND CONDITIONS OF SALE

All purchases are subject to Entegris' Terms and Conditions of Sale. To view and print this information, visit [entegris.com](https://www.entegris.com) and select the [Terms & Conditions](#) link in the footer.



Corporate Headquarters
129 Concord
Billerica, MA 01821
USA

Customer Service
Tel +1 952 556 4181
Fax +1 952 556 8022
Toll Free 800 394 4083

Entegris®, the Entegris Rings Design®, and other product names are trademarks of Entegris, Inc. as listed on [entegris.com/trademarks](https://www.entegris.com/trademarks). All third-party product names, logos, and company names are trademarks or registered trademarks of their respective owners. Use of them does not imply any affiliation, sponsorship, or endorsement by the trademark owner.

©2022 Entegris, Inc. | All rights reserved. | Printed in the USA | 9000-12000ENT-0522

www.entegris.com