

# Transition Metal Precursors

*High-purity, well-established metal-organic precursors from Group IV and Group V metals*

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 transition metal precursors are tailored to your manufacturing requirements and specifications to meet your high-quality customized needs.

We offer metalorganics from Group IV and Group V of the periodic table that are well-established precursors for the deposition of thin films. One of our focus areas is in amido and imido complexes of Group IV and Group V elements. This capability requires specific know-how in the safe handling of corrosive transition metal halides in both liquid and solid state, manipulation of pyrophoric reagents, and usage of liquified gases.

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/CVD precursors for semiconductor deposition
- Low temperature ALD processes
- Amido and imido complexes
- Clean ligand release with water or ozone

## Group IV

Titanium <b>Ti</b> TDMAT CAS: 3275-24-9	Group V
Zirconium <b>Zr</b> TEMAZ CAS: 175923-04-3	Niobium <b>Nb</b> TBTDEN CAS: 210363-27-2
Hafnium <b>Hf</b> TEMAH CAS: 352535-01-4	Tantalum <b>Ta</b> TBTDET CAS: 169896-41-7

## FEATURES & BENEFITS

**State-of-the-art, high performance distillation capabilities**

Perform well with chemistries sensitive to long thermal histories

**High-purity, well-established metal-organic precursors from Group IV and V metals**

Ideally suited for use in ALD/CVD thin film deposition

**Advanced scientific expertise and over 20 years of synthetic expertise in metal-organic chemistry**

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

<b>Tetrakis(ethylmethylamido)zirconium (TEMAZ)</b>			
<b>Chemical formula:</b>	C <sub>12</sub> H <sub>32</sub> N <sub>4</sub> Zr	<b>Boiling point:</b>	81°C (178°F), 0.1 mm/Hg
<b>Molecular weight:</b>	323.63 g/mol	<b>Flash point:</b>	11°C (52°F)
<b>CAS #:</b>	175923-04-3	<b>Density:</b>	1.049 g/mL

### Purity Analysis

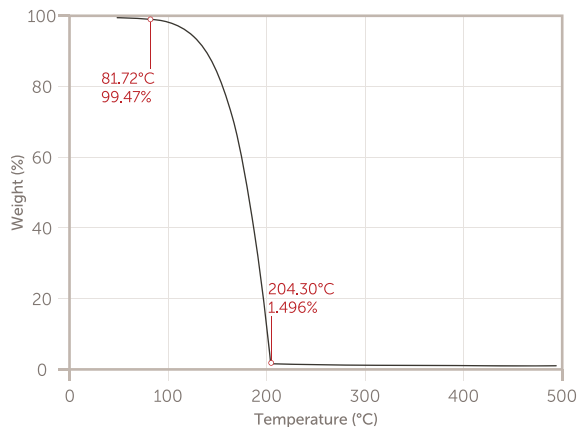
Parameter	Specification	Analytical method
Assay	99.5%	<sup>1</sup> H NMR
Chloride	≤10 ppm	IC
Aluminum	<50 ppb	ICP-MS
Antimony	<50 ppb	ICP-MS
Arsenic	<50 ppb	ICP-MS
Barium	<50 ppb	ICP-MS
Beryllium	<50 ppb	ICP-MS
Boron	<50 ppb	ICP-MS
Cadmium	<50 ppb	ICP-MS
Calcium	<50 ppb	ICP-MS
Chromium	<50 ppb	ICP-MS
Cobalt	<50 ppb	ICP-MS
Copper	<50 ppb	ICP-MS
Gallium	<50 ppb	ICP-MS
Germanium	<50 ppb	ICP-MS
Hafnium	<20,000 ppb	ICP-MS
Iron	<50 ppb	ICP-MS
Lead	<50 ppb	ICP-MS
Lithium	<50 ppb	ICP-MS
Magnesium	<50 ppb	ICP-MS
Manganese	<50 ppb	ICP-MS
Molybdenum	<50 ppb	ICP-MS
Nickel	<50 ppb	ICP-MS
Potassium	<50 ppb	ICP-MS
Sodium	<50 ppb	ICP-MS
Strontium	<50 ppb	ICP-MS
Thallium	<50 ppb	ICP-MS
Thorium	<50 ppb	ICP-MS
Tin	<50 ppb	ICP-MS
Titanium	<500 ppb	ICP-MS

## SPECIFICATIONS

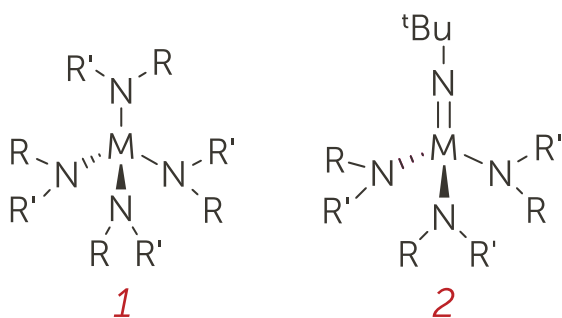
Tungsten	<50 ppb	ICP-MS
Uranium	<50 ppb	ICP-MS
Vanadium	<50 ppb	ICP-MS
Zinc	<50 ppb	ICP-MS

## PERFORMANCE DATA

### Thermal Gravimetric Analysis



## DRAWINGS



### Capabilities

With over 20 years of investment and expertise, Entegris is a leader in the high-volume manufacture of high-purity metalorganics based on Group IV and Group V metals and beyond. This capability requires specific know-how in the safe handling of corrosive transition metal halides in both liquid and solid state, manipulation of pyrophoric reagents, and usage of liquefied gases. As such, we have developed agile processes that allow for convenient customized syntheses of products with motifs such as **1** and **2**.

As an example, for a product with a motif of **1**, where base elements include Ti, Zr, and Hf, the amido ligands can be varied to suit specific physical properties or applications. The R and R' substituent can be the same or different depending on the targeted function; and can be drawn from a range of alkyl groups. Similarly, products with a motif of **2**, where elements include Nb and Ta, have an additional point for derivatization. tert-Butyl groups are commonly found as the imido substituent on compounds such as **2**, but other large alkyl groups such as neo-pentyl and tert-pentyl have shown to be effective on precursors for deposition.

#### FOR MORE INFORMATION

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