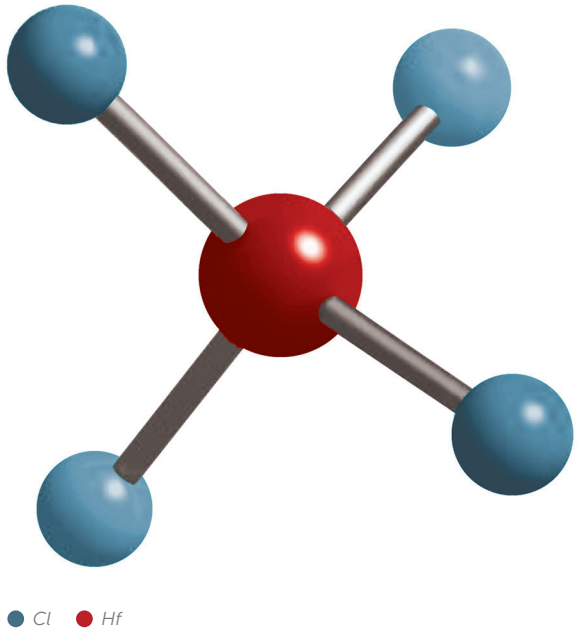
UltraPur™ $HfCl_4$

Hafnium tetrachloride



Hafnium tetrachloride is a solid metallic halide used widely in the semiconductor industry as a precursor for the formation of the high-κ dielectric material Hafnium Oxide. The major applications of HfO are High-κ Metal Gate (HKMG) transistors and capacitor structures. In the case of HKMG, HfO started to supersede conventional SiO_2 from the 45 nm or 32 nm node. For the deposition process, Atomic Layer Deposition (ALD) is the major method utilized in the industry for high-κ materials. In the ALD process, HfCl4 provides the source of Hf which, and a second precursor such as water or O_3 as the source of oxygen.

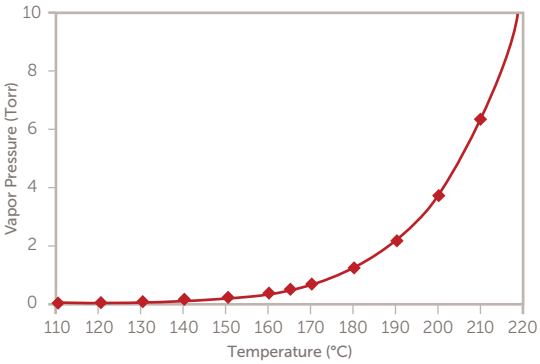
Hafnium tetrachloride is a fine powder that can be easily entrained in the carrier gas stream and result in particle defects on the wafer. Entegris has developed a proprietary process to agglomerate these particles in the vaporizer after filling to eliminate particle excursions from the precursor. The filling and post fill processing takes place in our state-of-the-art manufacturing facility in Burnet, Texas.

Delivery System

Entegris recommends its proprietary ProE-VAP® solid precursor delivery system for optimum flux and utilization of $HfCl_4$. This ampoule has an innovative design that maximizes solid precursor exposed area and heating to maximize overall mass flux and flux stability. Details of the ProE-VAP delivery system can be found on our separate data sheet. Please ask your Entegris representative.

PERFORMANCE DATA

Vapor Pressure Curve



APPLICATIONS

- Precursor for HfO high-κ layer deposition for HKMG and capacitor structures – high-κ layer, ALD deposition technique.

FEATURES & BENEFITS

- Semiconductor grade purity
- Optimized ProE-VAP delivery system for solid precursor delivery
- Two year shelf life from date of manufacturing
- Post fill morphology treatment to eliminate particle excursions

SPECIFICATIONS

Physical properties

Chemical formula	$HfCl_4$
Molecular weight	320.3
Density	3.89 g/cm³
Melting point	432°C (806.6°F)

Purity analysis

Element	Detection limit	Specification	Analytical method
Aluminum	0.200 ppb	500.000 ppm	ICP-MS
Antimony	0.200 ppb	2.000 ppm	ICP-MS
Arsenic	0.300 ppb	3.000 ppm	ICP-MS
Barium	0.200 ppb	3.000 ppm	ICP-MS
Cadmium	0.200 ppb	2.000 ppm	ICP-MS
Calcium	0.200 ppb	3.000 ppm	ICP-MS
Chromium	0.200 ppb	4.000 ppm	ICP-MS
Cobalt	0.200 ppb	2.000 ppm	ICP-MS
Copper	0.200 ppb	4.000 ppm	ICP-MS
Gallium	0.200 ppb	3.000 ppm	ICP-MS
Germanium	0.200 ppb	2.000 ppm	ICP-MS
Iron	0.200 ppb	25.000 ppm	ICP-MS
Lead	0.200 ppb	4.000 ppm	ICP-MS
Lithium	0.200 ppb	2.000 ppm	ICP-MS
Magnesium	0.200 ppb	2.000 ppm	ICP-MS
Manganese	0.300 ppb	3.000 ppm	ICP-MS
Nickel	0.200 ppb	3.000 ppm	ICP-MS
Potassium	0.200 ppb	11.000 ppm	ICP-MS
Sodium	0.200 ppb	12.000 ppm	ICP-MS
Strontium	0.200 ppb	2.000 ppm	ICP-MS

Purity analysis (continued)

Element	Detection limit	Specification	Analytical method
Tin	0.200 ppb	2.000 ppm	ICP-MS
Titanium	0.200 ppb	63.000 ppm	ICP-MS
Tungsten	0.200 ppb	2.000 ppm	ICP-MS
Uranium	0.200 ppb	13.000 ppm	ICP-MS
Zinc	0.200 ppb	15.000 ppm	ICP-MS
Zirconium	0.200 ppb	2000.000 ppm	ICP-MS

Parameter	Specification	Analytical method
Purity	99.70%	ICP-MS

FOR MORE INFORMATION

Please call your Regional Customer Service Center today to learn what Entegris can do for you. Visit **entegris.com** and select the Contact Us link to find the customer service center nearest you.

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