

Issue Date 28-May-2015

Revision Date 18-Dec-2015

Version H

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product identifier**Product Name** Niobium and Niobium Alloys**Other means of identification****Product No.** TA0021**Synonyms** Tantalum Niobium Alloy**Recommended use of the chemical and restrictions on use****Recommended Use** Alloy product manufacture.**Uses advised against****Details of the supplier of the safety data sheet****Manufacturer Address**Stanford Advanced Materials
23661 Birtcher Dr. Lake Forest, CA 92630 USA**Emergency telephone number****Emergency Telephone** +1 (949) 407-8904

2. HAZARDS IDENTIFICATION

Classification

This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Label elements**Emergency Overview****Appearance** Various massive product forms**Physical state** Solid**Odor** Odorless**Hazards not otherwise classified (HNOC)**

Not applicable

Other InformationWhen product is subjected to welding, burning, melting, sawing, brazing, grinding, buffing, polishing, or other similar heat-generating processes, the following potentially hazardous airborne particles and/or fumes may be generated
Titanium dioxide an IARC Group 2B carcinogen.Vanadium pentoxide (V₂O₅) affects eyes, skin, respiratory system

Soluble molybdenum compounds such as molybdenum trioxide may cause lung irritation

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms

Columbium and Columbium Alloys, Niobium Thermite Derby, (Product #512).

Chemical Name	CAS No.	Weight-%
Niobium (Columbium)	7440-03-1	40->99
Titanium	7440-32-6	0-60
Aluminum	7429-90-5	0-50
Tantalum	7440-25-7	0-30
Hafnium	7440-58-6	0-30
Tungsten	7440-33-7	0-20
Vanadium	7440-62-2	0-10
Molybdenum	7439-98-7	0-10
Zirconium	7440-67-7	0-5

4. FIRST AID MEASURES

First aid measures

Eye contact	In the case of particles coming in contact with eyes during processing, treat as with any foreign object.
Skin Contact	None under normal use conditions.
Inhalation	If excessive amounts of smoke, fume, or particulate are inhaled during processing, remove to fresh air and consult a qualified health professional.
Ingestion	Not an expected route of exposure.

Most important symptoms and effects, both acute and delayed

Symptoms None anticipated.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

Not flammable in the form of this product as distributed, flammable as finely divided particles or pieces resulting from processing of this product. Smother with salt (NaCl) or class D dry powder fire extinguisher.

Unsuitable extinguishing media Do not spray water on burning metal as an explosion may occur. This explosive characteristic is caused by the hydrogen and steam generated by the reaction of water with the burning material.

Specific hazards arising from the chemical

Intense heat. Very fine, high surface area material resulting from grinding, buffing, polishing, or similar processes of this product may ignite spontaneously at room temperature. WARNING: Fine particles resulting from grinding, buffing, polishing, or similar processes of this product may form combustible dust-air mixtures. Keep particles away from all ignition sources including heat, sparks, and flame. Prevent dust accumulations to minimize combustible dust hazard.

Hazardous combustion products Titanium dioxide an IARC Group 2B carcinogen. Vanadium pentoxide (V₂O₅) affects eyes, skin, respiratory system. Soluble molybdenum compounds such as molybdenum trioxide may cause lung irritation.

Explosion data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge None.

Protective equipment and precautions for firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH approved (or equivalent) respirator and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Use personal protective equipment as required.

For emergency responders Use personal protective equipment as required.

Environmental precautions

Environmental precautions Collect spillage to prevent release to the environment.

Methods and material for containment and cleaning up

Methods for containment Not applicable to massive product.

Methods for cleaning up Not applicable to massive product.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Very fine, high surface area material resulting from grinding, buffing, polishing, or similar processes of this product may ignite spontaneously at room temperature. WARNING: Fine particles resulting from grinding, buffing, polishing, or similar processes of this product may form combustible dust-air mixtures. Keep particles away from all ignition sources including heat, sparks, and flame. Prevent dust accumulations to minimize combustible dust hazard.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep chips, turnings, dust, and other small particles away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity).

Incompatible materials Dissolves in hydrofluoric acid. Ignites in the presence of fluorine. When heated above 200°C, reacts exothermically with the following. Chlorine, bromine, halocarbons, carbon tetrachloride, carbon tetrafluoride, and freon.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Chemical Name	ACGIH TLV	OSHA PEL
Niobium (Columbium) 7440-03-1	-	-
Titanium 7440-32-6	-	-
Aluminum 7429-90-5	TWA: 1 mg/m ³ respirable fraction	TWA: 15 mg/m ³ total dust TWA: 5 mg/m ³ respirable fraction
Tantalum 7440-25-7	-	TWA: 5 mg/m ³
Hafnium 7440-58-6	TWA: 0.5 mg/m ³ TWA: 0.5 mg/m ³ Hf	TWA: 0.5 mg/m ³
Tungsten 7440-33-7	STEL: 10 mg/m ³ STEL: 10 mg/m ³ W TWA: 5 mg/m ³ TWA: 5 mg/m ³ W	(vacated) STEL: 10 mg/m ³ (vacated) STEL: 10 mg/m ³ W
Vanadium 7440-62-2	-	Ceiling: 0.5 mg/m ³ V2O5 respirable dust Ceiling: 0.1 mg/m ³ V2O5 fume
Molybdenum 7439-98-7	TWA: 10 mg/m ³ inhalable fraction TWA: 3 mg/m ³ respirable fraction	-
Zirconium 7440-67-7	STEL: 10 mg/m ³ STEL: 10 mg/m ³ Zr TWA: 5 mg/m ³ TWA: 5 mg/m ³ Zr	TWA: 5 mg/m ³ Zr (vacated) STEL: 10 mg/m ³ (vacated) STEL: 10 mg/m ³ Zr

Appropriate engineering controls

Engineering Controls Avoid generation of uncontrolled particles.

Individual protection measures, such as personal protective equipment

Eye/face protection	When airborne particles may be present, appropriate eye protection is recommended. For example, tight-fitting goggles, foam-lined safety glasses or other protective equipment that shield the eyes from particles.
Skin and body protection	Fire/flame resistant/retardant clothing may be appropriate during hot work with the product. Cut-resistant gloves and/or protective clothing may be appropriate when sharp surfaces are present.
Respiratory protection	When particulates/fumes/gases are generated and if exposure limits are exceeded or irritation is experienced, proper approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminat concentrations. Respiratory protection must be provided in accordance with current local regulations.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Solid	Odor	Odorless
Appearance	Various massive product forms	Odor threshold	Not applicable
Color	metallic gray silver		
<u>Property</u>	<u>Values</u>	<u>Remarks • Method</u>	
pH	-		
Melting point/freezing point	1800-2500 °C / 3270-4530 °F		
Boiling point / boiling range	-		
Flash point	-	Not applicable	
Evaporation rate	-	Not applicable	
Flammability (solid, gas)	-	Not flammable in the form of this product as distributed, flammable as finely divided particles or pieces resulting from processing of this product	
Flammability Limit in Air			
Upper flammability limit:	-		
Lower flammability limit:	-		
Vapor pressure	-	Not applicable	
Vapor density	-	Not applicable	
Specific Gravity	5.6-11.9		
Water solubility	Insoluble		
Solubility in other solvents	-	Not applicable	
Partition coefficient	-	Not applicable	
Autoignition temperature	-		
Decomposition temperature	-	Not applicable	
Kinematic viscosity	-	Not applicable	
Dynamic viscosity	-	Not applicable	
Explosive properties	Not applicable		
Oxidizing properties	Not applicable		
<u>Other Information</u>			
Softening point	-		
Molecular weight	-		
VOC Content (%)	Not applicable		
Density	-		
Bulk density	-		

10. STABILITY AND REACTIVITY

Reactivity

Not applicable

Chemical stability

Stable under normal conditions.

Possibility of Hazardous Reactions

None under normal processing.

Hazardous polymerization Hazardous polymerization does not occur.

Conditions to avoid

Dust formation and dust accumulation.

Incompatible materials

Dissolves in hydrofluoric acid. Ignites in the presence of fluorine. When heated above 200°C, reacts exothermically with the following. Chlorine, bromine, halocarbons, carbon tetrachloride, carbon tetrafluoride, and freon.

Hazardous Decomposition Products

When product is subjected to welding, burning, melting, sawing, brazing, grinding, buffing, polishing, or other similar heat-generating processes, the following potentially hazardous airborne particles and/or fumes may be generated. Titanium dioxide an IARC Group 2B carcinogen. Vanadium pentoxide (V₂O₅) affects eyes, skin, respiratory system. Soluble molybdenum compounds such as molybdenum trioxide may cause lung irritation.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure**Product Information**

Inhalation Not an expected route of exposure for product in massive form.

Eye contact Not an expected route of exposure for product in massive form.

Skin Contact Product not classified.

Ingestion Not an expected route of exposure for product in massive form.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Niobium (Columbium) 7440-03-1	> 10,000 mg/kg bw	> 2000 mg/kg bw	-
Titanium 7440-32-6	> 5000 mg/kg bw	-	-
Aluminium 7429-90-5	15,900 mg/kg bw	-	> 1 mg/L
Tantalum 7440-25-7	> 2000 mg/kg bw	> 2000 mg/kg bw	> 5.18 mg/L
Hafnium 7440-58-6	> 5000 mg/kg bw	-	>4.3mg/L
Tungsten 7440-33-7	> 2000 mg/kg bw	> 2000 mg/kg bw	> 5.4 mg/L
Vanadium 7440-62-2	> 2000 mg/kg bw	-	-
Molybdenum 7439-98-7	> 2000 mg/kg bw	> 2000 mg/kg bw	> 5.10 mg/L
Zirconium 7440-67-7	> 5000 mg/kg bw	-	>4.3 mg/L

Information on toxicological effects

Symptoms None known.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Acute toxicity	Product not classified.
Sensitization	Product not classified.
Germ cell mutagenicity	Product not classified.
Carcinogenicity	Product not classified.

Reproductive toxicity	Product not classified.
STOT - single exposure	Product not classified.
STOT - repeated exposure	Product not classified.
Aspiration hazard	Product not classified.

12. ECOLOGICAL INFORMATION**Ecotoxicity**

This product as shipped is not classified for aquatic toxicity.

Chemical Name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Niobium (Columbium) 7440-03-1	-	-	-	-
Titanium 7440-32-6	The 72 h EC50 of titanium dioxide to <i>Pseudokirchnerella subcapitata</i> was 61 mg of TiO ₂ /L.	The 96 h LC50 of titanium dioxide to <i>Cyprinodon variegatus</i> was greater than 10,000 mg of TiO ₂ /L. The 96 h LC50 of titanium dioxide to <i>Pimephales promelas</i> was greater than 1,000 mg of TiO ₂ /L.	The 3 h EC50 of titanium dioxide for activated sludge were greater than 1000 mg/L.	The 48 h EC50 of titanium dioxide to <i>Daphnia Magna</i> was greater than 1000 mg of TiO ₂ /L.
Aluminum 7429-90-5	The 96-h EC50 values for reduction of biomass of <i>Pseudokirchneriella subcapitata</i> in AAP-Medium at pH 6, 7, and 8 were estimated as 20.1, 5.4, and 150.6 µg/L, respectively, for dissolved Al.	The 96 h LC50 of aluminum to <i>Oncorhynchus mykiss</i> was 7.4 mg of Al/L at pH 6.5 and 14.6 mg of Al/L at pH 7.5	-	The 48-hr LC50 for <i>Ceriodaphnia dubia</i> exposed to Aluminium chloride increased from 0.72 to greater than 99.6 mg/L with water hardness increasing from 25 to 200 mg/L.
Tantalum 7440-25-7	-	-	-	-
Hafnium 7440-58-6	The 72 h EC50 of hafnium to <i>Pseudokirchneriella subcapitata</i> was greater than 8 µg of Hf/L (100% saturated solution).	The 96 h LC50 of Hafnium dioxide in water to <i>Danio rerio</i> was greater than the solubility limit of 0.007 mg Hf/L.	-	The 48 h EC50 of Hafnium dioxide to <i>Daphnia magna</i> was greater than the solubility limit of 0.007 mg Hf/L.
Tungsten 7440-33-7	The 72 h EC50 of sodium tungstate to <i>Pseudokirchnerella subcapitata</i> was 31.0 mg of W/L.	The 96 h LC50 of sodium tungstate to <i>Danio rerio</i> was greater than 106 mg of W/L.	The 30 min EC50 of sodium tungstate for activated sludge were greater than 1000 mg/L.	The 48 h EC50 of sodium tungstate to <i>Daphnia magna</i> was greater than 96 mg of W/L.
Vanadium 7440-62-2	The 72 h EC50 of vanadium pentoxide to <i>Desmodesmus subspicatus</i> was 2,907 µg of V/L.	The 96 h LC50 of vanadium pentoxide to <i>Pimephales promelas</i> was 1,850 µg of V/L.	The 3 h EC50 of sodium metavanadate for activated sludge was greater than 100 mg/L.	The 48 h EC50 of sodium vanadate to <i>Daphnia magna</i> was 2,661 µg of V/L.
Molybdenum 7439-98-7	The 72 h EC50 of sodium molybdate dihydrate to <i>Pseudokirchneriella subcapitata</i> was 362.9 mg of Mo/L.	The 96 h LC50 of sodium molybdate dihydrate to <i>Pimephales promelas</i> was 644.2 mg/L	The 3 h EC50 of molybdenum trioxide for activated sludge was 820 mg/L.	The 48 h LC50 of sodium molybdate dihydrate to <i>Ceriodaphnia dubia</i> was 1,015 mg/L. The 48 h LC50 of sodium molybdate dihydrate to <i>Daphnia magna</i> was greater than 1,727.8 mg/L.
Zirconium 7440-67-7	The 14 d NOEC of zirconium dichloride oxide to <i>Chlorella</i>	The 96 h LL50 of zirconium to <i>Danio rerio</i> was greater	-	The 48 h EC50 of zirconium dioxide to <i>Daphnia magna</i>

	vulgaris was greater than 102.5 mg of Zr/L.	than 74.03 mg/L.		was greater than 74.03 mg of Zr/L.
--	--	------------------	--	---------------------------------------

Persistence and degradability

.

Bioaccumulation

.

Other adverse effects**13. DISPOSAL CONSIDERATIONS****Waste treatment methods**

Disposal of wastes Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated packaging None anticipated.

This product contains one or more substances that are listed with the State of California as a hazardous waste.

14. TRANSPORT INFORMATION

DOT Not regulated

15. REGULATORY INFORMATION**International Inventories**

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Does not comply
AICS	Does not comply

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory

DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances

ENCS - Japan Existing and New Chemical Substances

IECSC - China Inventory of Existing Chemical Substances

KECL - Korean Existing and Evaluated Chemical Substances

PICCS - Philippines Inventory of Chemicals and Chemical Substances

AICS - Australian Inventory of Chemical Substances

US Federal Regulations**SARA 313**

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

Acute health hazard	No
Chronic Health Hazard	No

Fire hazard No
Sudden release of pressure hazard No
Reactive Hazard No

CWA (Clean Water Act)

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

CERCLA

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Titanium 7440-32-6	X		
Aluminium 7429-90-5	X	X	X
Tantalum 7440-25-7	X	X	X
Hafnium 7440-58-6	X	X	X
Tungsten 7440-33-7	X	X	X
Vanadium 7440-62-2	X	X	X
Molybdenum 7439-98-7	X	X	X
Zirconium 7440-67-7	X	X	X

U.S. EPA Label Information

EPA Pesticide Registration Number Not applicable

16. OTHER INFORMATION

NFPA	Health hazards 0	Flammability 0	Instability 0	Physical and Chemical Properties -
HMIS	Health hazards 1*	Flammability 0	Physical hazards 0	Personal protection X
<i>Chronic Hazard Star Legend</i>	<i>* = Chronic Health Hazard</i>			

Issue Date 28-May-2015
Revision Date 18-Dec-2015
Revision Note

Note:

The information provided in this safety data sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

Provided by

Stanford Advanced Materials