



GaAs EPITAXIAL WAFER

Date Prepared : 15/Jan/2004

Revised: 31/Oct/2011 Revision 1

# MATERIAL SAFETY DATA SHEET

## 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Identifier: Gallium arsenide epitaxial wafer  
 Product Description: Crystalline gallium arsenide

**MANUFACTURER:**  
 Sumika Electronic Materials, Inc.  
 3832 E. Watkins Street  
 Phoenix, AZ 85034

**EMERGENCY CONTACT:**  
 CHEMTREC: (800) 424-9300

Recommended Use and Limitation on Use: For semiconductor device manufacturing use only

## 2. HAZARDS IDENTIFICATION

### EMERGENCY OVERVIEW:

GaAs is a cubic crystal with dark gray metallic sheen, subject to OSHA regulations under 29 C.F.R. 1910.1018. Arsenic compounds are generally known as a human carcinogen. They may be irritating to the respiratory tract, skin and eyes, may cause blood disorders and may affect the nervous system, heart, kidneys and liver. (1,2)

### GHS CLASS:

<b>Physicochemical Hazards</b>	Explosives:	Not Applicable
	Flammable gases:	Not Applicable
	Flammable aerosols	Not Applicable
	Oxidizing gases	Not Applicable
	Gases under pressure	Not Applicable
	Flammable liquids	Not Applicable
	Flammable solids	Classification not possible
	Self-reactive substances	Classification not possible
	Pyrophoric liquids	Not Applicable
	Pyrophoric solids	Classification not possible
	Self-heating substances	Classification not possible
	Substances which, in contact with water, emit flammable gases	Classification not possible
	Oxidizing liquids	Not Applicable
	Oxidizing solids	Classification not possible
	Organic peroxides	Not Applicable
	Corrosive to metals	Classification not possible

<b>Health Hazards</b>	Acute Toxicity (oral):	Not Applicable
	Acute Toxicity (dermal):	Classification not possible
	Acute Toxicity (inhalation: gas):	Not Applicable
	Acute Toxicity (inhalation: vapor):	Not Applicable
	Acute Toxicity (inhalation: dust, mist):	Classification not possible
	Skin corrosion, irritation:	Classification not possible
	Serious eye damage, eye irritation	Classification not possible
	Respiratory sensitization:	Classification not possible
	Skin sensitization	Not Classified
	Germ cell Mutagenicity	Not Classified
	Carcinogenicity:	Category 1A
	Reproductive Toxicity:	Category 1 (nerve system, digestive organs)
	Target Organ Systemic Toxicity (Single dose):	Category 1 (respiratory system, blood vessel)
	Target Organ Systemic Toxicity (Repeated dose):	Classification not possible
Aspiration Hazards:	Classification not possible	

<b>Environmental Hazards</b>	Acute hazardous to the aquatic: environment:	Classification not possible
	Chronic hazardous to the aquatic environment:	Classification not possible

**Symbol(s):**



**Signal Word(s):** Danger

**Hazard Information:** May cause cancer  
 May damage fertility or the unborn child(nerve system, digestive organs)  
 Causes damage to organs(respiratory system, blood vessel)

**Cautions**

**Preventive Measures** Obtain special instructions before use.  
 Do not handle until all safety precautions have been read and understood.  
 Use personal protective equipment as required.  
 Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.

Wash hands thoroughly after handling.  
 Do not eat, drink or smoke when using this product.

**Procedure:** If exposed or concerned: Get medical advice /attention  
 If exposed: Call a POISON CENTER or Doctor/physician.  
 Specific treatment

**Storage** Store locked up.

**Disposal:** Dispose contents/container in accordance with national, prefectural, and local regulations.

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

Product Type (single or Mixture): Single  
 Chemical Name or Generic Name: Gallium arsenide  
 Chemical Characteristics: Trade secret

COMPONENT	CAS No.	%	OSHA PEL	ACGIH TLV
Gallium arsenide *	1303-00-0	Ca. 100 %	0.01 mg(As)/m3	0.01 mg(As)/m3

\* Hazardous within the meaning of 29 C.F.R. 1910.1018

### 4. FIRST AID MEASURES

In all cases of exposure, the patient should be transferred to hospital as soon as possible.

- IF INHALED:** Immediately remove the victim to fresh air, keep warm with cover or blanket, and at rest. Make the victim blow nose and gargle. Immediately consult doctor. If breathing is weak or has stopped, open the victim's airway, loosen clothing, and administer oxygen or artificial respiration. If breathing but vomiting, turn the victim's head to the side. If unconscious, do not give anything by mouth. Do not induce vomiting. (1)
- IF ON SKIN:** Immediately take off contaminated clothing, shoes, etc. Rinse portions that contacted with this product with lukewarm running water. If any change in appearance or pain persists, immediately consult doctor. Because of the flammability of this product, take measures with caution to fire. (1)
- IF IN EYES:** Wash eyes immediately with large amounts of water or normal saline while holding eyes open, occasionally lifting upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). If contact lenses are used, unless adhered, remove them and rinse eyes. Do not rub eyes, nor do not let victim close eyes tightly. Get medical attention immediately. (1)

IF SWALLOWED: Rinse mouth thoroughly. May dilute in stomach with 1 or 2 glasses of water or milk. Cover body with blanket, keep warm and at rest. Immediately seek medical attention. As necessary, give artificial respiration or oxygen. If breathing but vomiting, turn victim's head to the side. If unconscious, do not give anything by mouth and do not induce vomiting.

PROTECTION OF FIRST AID PERSONNEL: Rescuer must wear protective equipment, such as gloves, goggles, and mask to avoid contact with hazardous material. Remove any contaminated clothing and protective equipment.

---

## 5. FIRE-FIGHTING MEASURES AND EXPLOSION HAZARD DATA

SUITABLE EXTINGUISHING MEDIA Dry chemical, carbon dioxide or dry sand. Do not use water.

UNSUITABLE EXTINGUISHING MEDIA: Water

FIRE-FIGHTING INSTRUCTIONS: Non-combustible, product itself doesn't burn but may decompose upon heating may produce very toxic fumes. Containers may explode when heated. Move containers from fire area if you can do it without risk. If you cannot, cool containers with flooding quantities of water spray until well after fire is out. Do not get water inside containers. Eliminate all ignition sources. Stay upwind. Keep unauthorized personnel away from fire and firefighting area. Avoid allowing materials cause for environmental pollution runoff. Avoid touching to heated product cause for burn.

SPECIAL PROTECTIVE EQUIPMENT FOR FIRE-FIGHTERS: Firefighters should wear self-contained breathing apparatus and full fire-fighting turnout gear against arsenic fumes and arsenic compounds.

HAZARDOUS DECOMPOSITION PRODUCTS: Gallium arsenide when exposed to high temperatures or in contact with strong acids or oxidizers can emit toxic fumes or arsine gas. Can react with steam, acids and acid fumes to evolve arsine gas. When heated to decompose it emits very toxic fumes of Arsine. In the presence of acids, it yields arsine.

---

## 6. ACCIDENTAL RELEASE MEASURES

Carefully sweep up or wet the material before cleanup, place in stoppered or closed container, and wear respirator with High Efficiency Particulate Air (HEPA) filter, gloves, safety goggles and suitable protective clothing. (4) Stay upwind. Keep unauthorized personnel away from released area. All released materials should be collected to avoid environmental pollution.

Dispose of all wastes in accordance with federal, state and local regulations.

---

## 7. HANDLING AND STORAGE

### PRECAUTIONS:

- Wear gloves, safety goggles, HEPA respirator and suitable protective clothing when handling. (4)
- Use with local exhaust ventilation. (4)
- Put in stoppered or closed containers and keep locked up.
- Avoid contact with acids and steam.

---

## 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

### EXPOSURE LIMITS:

- ACGIH TLV: 0.01 mg(As)/m<sup>3</sup> [TWA]  
(Arsenic, elemental and inorganic compounds) (5)
- OSHA PEL: 0.01 mg(As)/m<sup>3</sup> [TWA] (6)
- NIOSH: 0.002 mg(As)/m<sup>3</sup> · 15min [CL] (7)

### ENGINEERING CONTROLS (VENTILATION):

- Provide local exhaust or process enclosure ventilation to keep airborne concentration below the permissible exposure limits. (1)

### PERSONAL PROTECTION:

#### RESPIRATORY PROTECTION:

- Wear appropriate protective apparatus (legal requirements by the Occupational Safety and Health Administration found in 29 C.F.R. 1910.1018 (See appendix)). (1)

#### HAND, SKIN AND BODY PROTECTION:

- Wear appropriate protective (impervious) clothing, equipment and gloves to prevent contact with this substance. Protective clothing and gloves should meet the requirements for protective work clothing and equipment in 29 C.F.R. 1910.1018(j). (1)

#### EYE PROTECTION:

- Wear splash-proof or dust-resistant safety goggles with or without a face shield to prevent contact with this substance. Should provide an eye wash fountain within the immediate work area for emergency use. (1)

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

- APPEARANCE: Dark gray metallic sheen chip
- ODOR: No order
- PHYSICAL STATE: Solid
- pH: Not applicable
- VAPOR PRESSURE: Not available
- VAPOR DENSITY: Not available
- BOILING POINT: Not known
- MELTING POINT: 1,238 °C
- SPECIFIC GRAVITY: 5.31 (at 25 °C)
- SOLUBILITY in water: Practically insoluble
- SOLUBILITY in other solvents: Not available
- PERCENT VOLATILE: Not applicable
- EVAPORATION RATE: Not applicable

---

## 10. STABILITY AND REACTIVITY

STABILITY:	Stable
CONDITIONS TO AVOID:	Finely divided GaAs can react vigorously with strong acids and oxidizers. Also avoid high temperatures and steam to prevent release of arsenic fumes or arsine gas.
INCOMPATIBILITY:	Strong acids and oxidizing agents and steam.
HAZARDOUS DECOMPOSITION PRODUCTS:	See Section 5.
HAZARDOUS POLYMERIZATION:	Will not occur

---

## 11. TOXICOLOGICAL INFORMATION

### Gallium arsenide *epitaxial wafer*

No data available.

### Gallium arsenide

#### HUMAN EFFECTS:

Acute poisoning symptoms: peripheral nerve disorder, multiple neuritis, nausea, vomiting, stomach pain diarrhea, cardiomyopathy, renal damage.

Chronic poisoning symptoms: Chronic bronchitis, inflammation of the peripheral blood vessel, anemia, portal liver cirrhosis, renal damage

#### ACUTE ORAL EFFECTS:

No effect or death was observed in mice given up to 5000 mg/kg of this substance. (10) 1000 mg/kg of this substance produced only mild diarrhea and constipation in hamsters. (1) Inorganic arsenic compounds may cause systemic poisoning with adverse effects to the nervous system, gastrointestinal tract, the liver, the kidneys, hematopoietic and cardiovascular systems, and the skin. (1,3)

#### ACUTE INHALATION EFFECTS:

Dust of this substance introduced into respiratory system caused dystrophy of liver and kidneys, and inflammatory and sclerotic changes in lungs. (1,3) Intratracheal instillation with the particulates of this substance, characterized with a mean count diameter of 8.3  $\mu\text{m}$  developed signs of systemic arsenic intoxication, pulmonary inflammation, and pneumocyte hyperplasia. (3) Decreasing the particle mean count to 1.63  $\mu\text{m}$  increased the severity of pulmonary lesions. (3) Inorganic arsenic compounds may cause irritation of the respiratory tract. (1)

#### EYE IRRITATION:

No relevant information of this substance has been found. Inorganic arsenic compounds may cause irritation and conjunctivitis with itching, burning, lacrimation, photophobia and sometimes hyperemia and chemosis. (1)

#### SKIN IRRITATION:

This substance showed no allergic response when tested in Guinea pigs by Buhler methods. (9) Inorganic arsenic compounds may be irritating especially with prolonged contact. (1)

**SUBCHRONIC / CHRONIC EFFECTS:**

Chronic inhalation of 4.2 mg/m<sup>3</sup> inhibited growth and decreased the number of erythrocytes in rats and Guinea pigs. (3) Chronic exposure to inorganic arsenic compounds may cause adverse effects to the nervous system, the respiratory system, digestive organ, the liver, the kidneys, the heart and the skin. (1,3) May cause blood disorder. (1)

A significant elevation of lipids, protein and DNA were found in the lungs of GaAs treated rats. There was also an increase in wet and dry lung weight after GaAs exposure.

**CARCINOGENICITY:**

Arsenic and Inorganic arsenic compounds cause skin and lung cancer in human, and are listed as a human carcinogen by IARC (Group 1) and OSHA. (Gallium Arsenide)

**MUTAGENICITY:**

Ames Test: Negative

in vivo micronucleus assays (peripheral): Negative

**TERATOGENETIC EFFECTS:**

Inhalation exposure of GaAs to pregnant rats on 4-19 days of gestation (10-75 mg/m<sup>3</sup> GaAs, 6 hr/day, 7 days/week)

Effect: Developmental toxicity in the form of concentration-related growth retardation, evidenced as reduced fetal body weight and an increased evidence of skeletal variations became statistically significant at 37 mg/m<sup>3</sup>. Pregnant and virgin rats exhibited signs of pulmonary toxicity (dyspnea and grey, mottled lungs); however, there were no effects on maternal body weight.

NOAEL: 10 mg/m<sup>3</sup>.

Inhalation exposure of GaAs to pregnant rats on 4-17 days of gestation (10-75 mg/m<sup>3</sup> GaAs, 6 hr/day, 7 days/week)

Effect: There were signs of embryoletality, fetal growth retardation, significant increases in the incidence of fetal variations (primarily sternabral defects), and a slight but not statistically significant increase in the incidence of fetal malformations. Minimal pulmonary toxicity was observed in the 10-mg/m<sup>3</sup> group, so that a NOAEL was not achieved in this study.

**MALE REPRODUCTIVE TOXICITY:**

Intratracheal instillation (7.7 mg/kg twice a week a total of 16 times; hamsters and rats).

Effect: Significant reduction in epididymal sperm count was observed. A significant proportion of the sperm were malformed.

**OTHER INFORMATION:**

Inorganic arsenic compounds may cause eye irritation and conjunctivitis with itching, burning, lacrimation, photophobia and sometimes hyperemia and chemosis.

Inorganic arsenic compounds may cause skin irritation.

Arsenic and organic arsenic compounds are listed as germ cell mutagen group 3A by Deutsche Forschungsgemeinschaft List of MAK and BAT value.

---

## **12. INFORMATION ON ENVIRONMENTAL INFLUENCE**

BIODEGRADABILITY: No relevant information found.

BIOACCUMULATION: No relevant information found.

FISH TOXICITY: No relevant information found.

---

### 13. DISPOSAL CONSIDERATIONS

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

---

### 14. TRANSPORT INFORMATION (not meant to be all inclusive)

DOT Proper Shipping Name: Arsenic compounds, solid, N.O.S. inorganic, including arsenates, N.O.S.; arsenates, N.O.S.; arsenic sulfides, N.O.S.; and organic compounds of arsenic, N.O.S.  
DOT Hazard Class: 6.1  
DOT ID Number: UN1557

---

### 15. REGULATORY INFORMATION (not meant to be all inclusive)

TSCA: listed  
CERCLA: not listed  
SARA Title III 311/312 Hazard Categories: not listed  
SARA Title III 302: not listed  
SARA Title III 313 Reportable Ingredients: not listed  
Risk Management Plan: not listed  
Process Safety Management: not listed  
Listed as a Toxic or Hazardous Substance in the following states: none  
Californian Proposition 65: not listed

---

### 16. OTHER INFORMATION

REVISION SUMMARY: Initial Release.

31 /October/ 2011 - Rev. 1 – added GHS Hazard summary, updated first aid measures, Toxicological information, Transportation information

NFPA RATINGS for GaAs: Health Hazard = 3 Flammability = 1 Reactivity = 2 Special (other) = W

REFERENCES:

- 1) OHS, MSDS-OHS file, STN on-line(1994)
- 2) E.E.Sikorski et al., Toxicol. Appl. Pharmacol., 110,129-142(1991)
- 3) NLM, "The Hazardous Substances Data Bank",HSDB file, STN on-line(1994)
- 4) Sigma-Aldrich Co., "Material Safety Data Sheets", (5/93-7/93,CD-ROM)
- 5) ACGIH, "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices 1993-1994" (1993)
- 6) OSHA, Code of federal regulations, 29 C.F.R. Part 1910,§1910.1018(4-1-94 edition, 1994)
- 7) NIOSH, "Registry of Toxic Effects of Chemical Substances" (1994)
- 8) Sumitomo Chemical Co., Ltd., Sumitomo Chemical Technical Report, S82-004 (1982)
- 9) S.Ohyama et al., Appl. Organomet. Chem., 2,333-337 (1988)
- 10) A.Tanaka et al., Appl. Organomet. Chem., 4,231-237 (1990)
- 11) IARC, "IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to men", Suppl.7, (1974)
- 12) T.J.Mast et al., "Inhalation Developmental Toxicology Studies : Gallium Arsenide in Mice and Rats", PNL-7367,NTIS DF91005300 (1990)



- 13) OSHA, "OSHA Instruction CPL 2-2.38C, OCT 22 1990", Office of Health Compliance Assistance, (1990)

*The information is believed to be accurate and represents the best information currently available to us. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.*

**APPENDIX**

29 C.F.R. 1910.1018

*Table 1 - Respiratory Protection for Inorganic Arsenic Particulates Except for Those With Significant Vapor Pressure*

<b>Concentration of Inorganic (as As) or condition of use</b>	<b>Required respirator</b>
(i) Unknown or greater or lesser than 20,000 µg/m3 (20 mg/m3) or fire fighting.	(A) Any full facepiece self-contained breathing apparatus operated in positive pressure mode.
(ii) Not greater than 20,000 µg/m3 (20 mg/m3).	(A) Supplied air respirator with full facepiece, hood, or helmet or suit and operated in positive pressure mode.
(iii) Not greater than 10,000 µg/m3 (10 mg/m3).	(A) Powered air-purifying respirators in all inlet face coverings with high efficiency filters.* (B) Half-mask supplied air respirators operated in positive pressure mode.
(iv) Not greater than 500 µg/m3.	(A) Full facepiece air-purifying respirator equipped with high-efficiency filter.* (B) Any full facepiece supplied air respirator. (C) Any full facepiece self-contained breathing apparatus.
(v) Not greater than 100 µg/m3.	(A) Half-mask air-purifying respirator equipped with high-efficiency filter.* (B) Any half-mask supplied air respirator.

\* High-efficiency filter: 99.97% efficiency against 0.3 micrometer monodisperse diethyl-hexyl phthalate (DOP) particulates.