

MATERIAL SAFETY DATA SHEET

1. PRODUCT & COMPANY IDENTIFICATION

- 1.1 Product Name : Gallium Arsenide Phosphide (GsAsP) Chip
 Style/Item No : GsAsP (HO,HY,SO,HOD TYPE)
- 1.2 Company Identification :
- Supplier : TYNTEK CORPATION
 Name : Mr. C. K. Perng
 Address : 1378 Ren-Ay Rd.Chunan-Jenn.Miaulih350, Taiwan, R.O.C.
 Telephone : 037-582997
 Facsimile : 037-580866
 e-mail : 187@serv.tyntek.com.tw
- 1.3 Emergency Contact : Mr. James Kung
 Telephone : 037-582997
- 1.4 Manufacturer :
- Supplier : TYNTEK CORPATION
 Name : Mr. C. K. Perng
 Address : 1378 Ren.Ay Rd.Chunan-Jenn.Miaulih350, Taiwan, R.O.C.
 Telephone : 037-582997

2. COMPOSITION/INFORMATION ON INGREDIENTS

- 2.1 Component : Epitaxial layer :
 Gallium arsenide phosphide(GaAs(1-x)P(x)) less than 30%
 (0 < x < 1)
 Gallium arsenide or gallium phosphide more than 70%
- 2.2 Hazard Identification : T, Toxic
- 2.3 CAS NO. : 12044-20-1(GaAsP),1303-0030(GaAs),12063-98-8(GaP)
- 2.4 UN Class : Not assigned
- 2.5 UN NO. : Not assigned

3. HAZARDS IDENTIFICATION

- 3.1 MOST IMPORTANT HAZARDS Only those arsenic compounds are considered toxic which
 Adverse Human Health Effects : may result form thermal decomposition and/or chemical
 reactions of GaAs, esp.
 – Diarsenic trioxide
 – Arsenic hydride

Poisoning by arsenic compounds can cause irritation of skin and mucous membranes; can damage heart, liver, blood, nerves and metabolism.

Poisoning may result from inhalation and ingestion of dust and mist which occur when handling substance. As result of thermal decomposition arsenic is released. Arsenic can cause cancer in humans.

4. FIRST AID MEASURES

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| 4.1 Potential routes of exposure | Inhalation, skin, oral, and eye |
| 4.2 After skin contact | Wash with water and soap. |
| 4.3 After eye contact | Wash eyes with plenty of water for at least 15minutes. |
| 4.4 After ingestion | Wash a mouth with plenty of water, and vomit intentionally.
Get medical attention. |
| 4.5 After inhalation | Remove from exposure area to fresh air immediately, get medical attention immediately. |

5. FIRE FIGHTING MEASURES

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| 5.1 General : | Gallium arsenide Phosphide epitaxial wafer is nonflammable.
It is subject to decomposition at high temperatures.
No special extinguishing media needed, adjust |
| 5.2 Appropriate extinguishing media : | extinguishing measures to environment. |
| 5.3 Unsuitable extinguishing media (for safety reasons) | None |
| 5.4 Special hazards caused by substance, combustion products and emerging gases : | Combustion products which are As_2O_3 , arsine gas, and arsenic fumes fumes can be hazardous. |
| 5.5 Special protection for fire-fighters : | Respiratory protection because of As_2O_3 , arsine, and arsenic fumes. |

6. ACCIDENTAL RELEASE MEASURES

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| 6.1 Personal protection : | Take precautions during mechanical working and chemical Reactions. Provide good ventilation in manufacturing rooms, exhausts at machines, avoid skin contact. |
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- 6.2 Environmental protection : Do not pass fine-grained GaAsP epitaxial wafer (suspensions) into Sewerage system (see # 13.1)
- 6.3 Methods for cleaning up : Wipe with pulp and place in suitable close containers. Sweep up with special vacuum cleaner and place in suitable close containers.

7. HANDLING AND STORAGE

- 7.1 Handling, measures for safe handling : Avoid formation of dust and wear gloves when handling. (See # 6.1)
- 7.2 Storage, requirements to storage rooms, containers and conditions : Keep dry, close container and store in the roomtemperature

8. EXPOSURE CONTROL AND PERSONAL PROTECTION

- 8.1 Design of technical equipment : Provide exhausts/covers for equipment and machines where formation of dust and gaseous arsenic compounds is to be expected.
- 8.2 Occupational exposure limit : Not available for GaAsP epitaxial wafer.
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|--------------------------|--------------------------------------|
| Diarsenic trioxide dust. | Determined as arsenic in total |
| | OSHA PEL TWA 0.01 mg/m ³ |
| | ACGIH TLV TWA 0.01 mg/m ³ |
| Arsine | OSHA PEL TWA 0.05 ppm |
| | ACGIH TVL TWA 0.05 ppm |
| Arsenic | OSHA PEL TWA 0.01 mg/m ³ |
| | ACGIH TLV TWA 0.01 mg/m ³ |
- 8.3 Personal protection :
- Respiratory protection : Wear Appropriate NIOSH/MSHA approved respirator.
- Hand protection : Chemical-resistant gloves
- Eye protection : Full facemask for dusts, vapors.
- Body protection : Depends on working place(coat, suit, overall, etc.)
- 8.4 Further information : Avoid skin contact, do not eat, smoke, drink during work, do not keep food in working rooms, wear appropriate clothing, change soiled clothing, wash hands after work.

Intraperitoneal LD50(mouse) 4.7 g/Kg

Oral LD50(mouse)8.0g/kg

Inorganic arsenic compounds may be dangerous to human life(oral from 0.6mg/kg)

After inhalation :

For human beings the threshold of response to arsenic Compounds (with regard to As in total dust) is :

ACGIH TLV TWA 0.01 mg/m³.

May cause inflammation of mucous membranes in Respiratory tract.

After ingestion :

Ingestion of arsenic compounds of 50 μ g/kg/day causes Disturbances of digestive tract and kidneys, changes of blood , skin irritation etc.

After skin contact :

Arsenic compounds may cause dermatitis of skin.

11.2 Chronic effect :

Arsenic compounds may cause cancer of lungs and skin in human beings.

GaAs was dosed for the hamster in amounts of 0.25mg/time \times 1time/week \times 15weeks,but lung cancer wasn't admitted.

11.3 Carcinogenicity :

IARC : Human carcinogen(group 1)

OSHA : Cancer hazard

NTP : Human carcinogen

12. ECOLOGICAL INFORMATION

12.1 Degradability and biodegradability :

Not degradable.

12.2 Biological accumulation :

Not available

12.3 Toxicity to fish :

Not available for GaAsP, LC50 killifish $> 10 \mu$ g/ml(GaAs)

Diarsenic trioxide :

LC50 goldfish 32 mg/1/7 days

LC50 water organisms 10-1mg/1/96 hours

Aquatic toxicity rate TLm96 : 10-1 ppm

5.3 mg/l poisonous for trout after 8 days, from 1 mg/l carcinogen for water organisms.

13. DISPOSAL CONSIDERATIONS

- 13.1 Product : Compact material is recycled(e.g. controlled thermal decomposition) or disposed according to RCRA Hazardous Waste Regulations or state regulations (in United States).
- 13.2 Soiled package : Special package for GaAs wafers can be reused after special cleaning, other package contaminated by As to be disposed of in controlled dumps.

14. TRANSPORT INFORMATION

- 14.1 Transport classification : UN-number Not assigned
(ADR/RID ; GGVS/GGVE ; AND/ADNR ; IMDG/GGVSee; ICAO-TI ; IATA-DGR) Not applicable
- 14.2 Transport information : There are no special regulations since GaAsP epitaxial wafer is not hazardous under normal transport conditions (fire and impact of acids excluded). This is also true, if GaAsP epitaxial wafer is released from package in an accident.

15. REGULATORY INFORMATION

Follow all regulations in your country.

16. OTHER INFORMATION

16.1 References :

- 1) ACGIH TLVs and BEIs Threshold Limit Values for Chemical Substances and Physical Agents(1998)
- 2) SAX's Dangerous Properties of Industrial Materials (1995)
- 3) Roschina T.A. : Gig Tr Prof Zabol,10 ; 30-33, (1966)
- 4) Fadeev A.I. : Gig Tr Prof Zabol,24(3),45, (1980)
- 5) MSDS Freiburger Compound Materials GmbH (1997)
- 6) NTP Chemical Repository Gallium Arsenide (Radian Corporation 1990)
- 7) Ohyama S. : Applied Organometallic Chemistry, 2, 333, (1988)
- 8) MSDS Hewlett-Packard Opto Electronics Division (1996)

Aforementioned data are based on our present knowledge and experience. The data sheet describes our product with regard to safety requirements but does not guarantee properties.

The buyer of our products is responsible for observing valid laws and regulations.