

# 2DSemiconductors Inc., USA

## Section 1: Chemical Product and Identification

**Product Name:** Phosphorus, black

**Catalog Codes:**

**CAS#:**

**RTECS:**

**TSCA:**

**CI#:** Not available.

**Synonym:** Phosphorus, crystalline, black

**Chemical Name:** Phosphorus (black)

**Chemical Formula:** P

## Section 2: Composition and Information on Ingredients

**Composition:** 100% phosphorus (P)

**Name** Phosphorus, black

**CAS #** Not listed

**% by Weight** 100

**Toxicological Data on Ingredients:** Phosphorus, black LD50: Not available. LC50: Not available.

## Section 3: Hazards Identification

### Potential Acute Health Effects:

Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Severe over-exposure can result in death.

### Potential Chronic Health Effects:

**CARCINOGENIC EFFECTS:** Not available. **MUTAGENIC EFFECTS:** Not available. **TERATOGENIC EFFECTS:** Not available.

**DEVELOPMENTAL TOXICITY:** Not available. The substance is toxic to kidneys, liver. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs

## Section 4: First Aid Measures

**Eye Contact:** Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

**Skin Contact:** In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

**Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

**Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

**Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

**Ingestion:** If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

**Serious Ingestion:** Not available.

## Section 5: Fire and Explosion Data

**Flammability of the Product:** Flammable.

**Auto-Ignition Temperature:** 260°C (500°F)

**Flash Points:** Not available.

**Flammable Limits:** Not available.

**Products of Combustion:** Not available.

### **Fire Hazards in Presence of Various Substances:**

Flammable in presence of open flames and sparks, of heat, of oxidizing materials. Non-flammable in presence of shocks.

### **Explosion Hazards in Presence of Various Substances:**

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of oxidizing materials.

### **Fire Fighting Media and Instructions:**

Flammable solid. **SMALL FIRE:** Use DRY chemical powder. **LARGE FIRE:** Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

### **Special Remarks on Fire Hazards:**

COMBUSTIBLE SOLID. Under fire situations, the more hazardous white phosphorus may be formed. When heated to decomposition it emits irritating fumes. May ignite with friction or contact with oxidizers. Combustion by-products include oxides of phosphorus, phosphine, phosphoric acid if water is present. Catches fire when heated in air to about 260 C and burns with formation of the pentoxide. Burns with a

pale green light when heated in an atmosphere of chlorine. Phosphorus boiled with alkaline hydroxides yields mixed phosphines which may ignite spontaneously in air black phosphorus and boron triiodide or lead dioxide, or zirconium or sodium peroxide react with incandescence. Phosphorus ignites the vapor of nitric acid and burns with an intense white light.

#### **Special Remarks on Explosion Hazards:**

Explosions may result on contact or friction. Finely divided phosphorus with bromates, chlorates, and iodates of barium, calcium, magnesium, potassium, sodium, or zinc will explode with heat, percussion, or sometimes light friction. Dangerous explosion hazard by chemical reaction with Antimony pentafluoride, Barium bromate, Beryllium, Calcium bromate, Magnesium bromate, Potassium bromate, Sodium bromate, Zinc bromate, Bromine, Bromine trifluoride, BrN<sub>3</sub>, Cesium, CsHC<sub>2</sub>, Cs<sub>3</sub>N, Chlorite, (Cl<sub>2</sub> + heptane), ClO, Chlorine trifluoride, Chlorate, CrO<sub>3</sub>, Cr(OCI)<sub>2</sub>, copper, NCl, Iodine monobromide, Iodine monochloride, Iodine pentafluoride, Iron, Lanthanum, Li<sub>2</sub>C<sub>2</sub>, Li<sub>6</sub>CS, magnesium perchlorate, manganese, Neodymium, nickel, nitrates (silver nitrate), NBr, Nitrogen dioxide, Nitrogen bromide, Nitrogen chloride, NOF, FNO<sub>2</sub>, oxygen, performic acid, Platinum, K<sub>3</sub>N, K<sub>2</sub>O<sub>2</sub>, RbHC<sub>2</sub>, Se<sub>2</sub>Cl<sub>2</sub>, SeOF<sub>2</sub>, SeF<sub>4</sub>, Na<sub>2</sub>C<sub>2</sub>, Na<sub>2</sub>O<sub>2</sub>, Thorium, peroxyformic acid, halogen azides, hexalithium disilicide, vanadium oxytrichloride, sodium peroxide

## **Section 6: Accidental Release Measures**

**Small Spill:** Use appropriate tools to put the spilled solid in a convenient waste disposal container.

#### **Large Spill:**

Flammable solid. Poisonous solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

## **Section 7: Handling and Storage**

#### **Precautions:**

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, alkalis.

#### **Storage:**

Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

## **Section 8: Exposure Controls/Personal Protection**

#### **Engineering Controls:**

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

#### **Personal Protection:**

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid

inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

**Exposure Limits:**

TWA: 0.02 (ppm) from ACGIH (TLV) [United States] TWA: 0.1 (mg/m3) from OSHA (PEL) [United States]  
TWA: 0.1 (mg/m3)

from NIOSH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: none

Taste: Not available.

Molecular Weight: 30.974 g/mole

**Color:** black. (Dark.

**pH (1% soln/water):** Not applicable.

**Boiling Point:** Not available.

**Melting Point:** Sublimation temperature: ~550°C

**Critical Temperature:** 720.85°C (1329.5°F)

**Specific Gravity:** 2.69 (Water = 1)

**Vapor Pressure:** Not applicable.

**Vapor Density:** Not available.

**Volatility:** Not available.

**Odor Threshold:** Not available.

**Water/Oil Dist. Coeff.:** Not available.

**Ionicity (in Water):** Not available.

**Dispersion Properties:** Not available.

**Solubility:** Very slightly soluble in cold water. Insoluble in hot water, diethyl ether. Insoluble in ammonia, carbon disulfide. Soluble in absolute alcohol.

## Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Heat, ignition sources, incompatible materials, dust generation

**Incompatibility with various substances:** Reactive with oxidizing agents, alkalis.

**Corrosivity:** Non-corrosive in presence of glass.

**Special Remarks on Reactivity:**

Reacts with halogens, halides, selenium oxychloride, iodine, oxygen, chlorine, sulfur, oxidizing materials (i.e. potassium permanganate, potassium chlorate, peroxides, etc.); finely divided phosphorus with bromates, chlorates, and iodates of barium, calcium, magnesium, potassium, sodium, or zinc. Reacts with strong alkali to form highly toxic phosphine gas. Phosphorus reacts vigorously below 250 deg C with any of the following materials: cesium, lithium, potassium, rubidium, sodium, sulfur.

**Special Remarks on Corrosivity:** Not available.

**Polymerization:** Will not occur.

## Section 11: Toxicological Information

**Routes of Entry:** Inhalation. Ingestion.

**Toxicity to Animals:**

LD50: Not available. LC50: Not available.

**Chronic Effects on Humans:** Causes damage to the following organs: kidneys, liver.

**Other Toxic Effects on Humans:** Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

**Special Remarks on Toxicity to Animals:**

Lowest Published Lethal Dose: LDL [Man] - route: unreported; Dose: 4412 ug/kg

**Special Remarks on Chronic Effects on Humans:** Not available.

**Special Remarks on other Toxic Effects on Humans:**

Acute Potential Health Effects: Skin: Causes skin irritation. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract irritation. Ingestion: black Phosphorus is nonvolatile, insoluble, and unabsorbable and is considered nontoxic when ingested. However, it may contain traces of toxic white phosphorus (up to 100ppm) and large ingestions may result in adverse systemic effects (central nervous system effects, cardiovascular system effects, and hypoglycemia). May cause irritation of the digestive tract, with vomiting, diarrhea, stomach pains. May cause kidney and liver damage. In general, depending on the intensity and duration of exposure, the effects may vary from mild irritation to severe

**Section 12: Ecological Information**

**Ecotoxicity:** Not available.

**BOD5 and COD:** Not available.

**Products of Biodegradation:**

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

**Toxicity of the Products of Biodegradation:** The products of degradation are as toxic as the original product.

**Special Remarks on the Products of Biodegradation:** Not available.

**Section 13: Disposal Considerations****Waste Disposal:**

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

**Section 14: Transport Information**

**DOT Classification:** CLASS 4.1: Flammable solid.

**Identification:** : Phosphorous, UNNA: 1338 PG: III

**Special Provisions for Transport:** Not available.

**Section 15: Other Regulatory Information****DSCL (EEC):**

R11- Highly flammable. R16- Explosive when mixed with oxidizing substances. S7- Keep container tightly closed. S23- Do not

breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical

advice. S36- Wear suitable protective clothing.

**HMIS (U.S.A.):**

**Health Hazard:** 2

**Fire Hazard:** 2

**Reactivity:** 0

**Personal Protection:** E

**National Fire Protection Association (U.S.A.):**

**Health:** 1

**Flammability:** 1

**Reactivity:** 1

**Specific hazard:**

**Protective Equipment:**

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

## **Section 16: Other Information**

*The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall 2Dsemiconductors Inc. and their affiliates be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if 2Dsemiconductors Inc. and their affiliates have been advised of the possibility of such damages.*