



Cu substrate SAFETY DATA SHEET

SECTION 1. IDENTIFICATION

Product Identity: Copper substrate.

Trade Names and Synonyms: Cu-Single crystal substrate

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Product Use: Copper is used for metal, alloy film and biological materials .

SECTION 2. HAZARDS IDENTIFICATION

CLASSIFICATION:

NOTE: In the form in which it is sold, this product is not regulated as a Hazardous Product in the U.S. or Canada. This Safety Data Sheet is provided for information purposes only.

Health	Physical	Environmental
Acute Toxicity (Oral, Inhalation) – Does not meet criteria	Does not meet criteria for any Physical Hazard	Aquatic Toxicity – (Short Term/Long Term) Does not meet any criteria
Skin Corrosion/Irritation – Does not meet criteria		
Eye Damage/Eye Irritation – Does not meet criteria		
Respiratory or Skin Sensitization – Does not meet criteria		
Mutagenicity – Does not meet criteria		
Carcinogenicity – Does not meet criteria		
Reproductive Toxicity – Does not meet criteria		
Specific Target Organ Toxicity:		
Acute Exposure – Does not meet criteria		
Chronic Exposure – Does not meet criteria		

LABEL:

Symbols: None required	Signal Word: None required
<u>Hazard Statements</u>	<u>Precautionary Statements:</u>
None required	None required

Emergency Overview: Reddish metal that does not burn in bulk. Copper dust clouds will not explode readily, if at all, in air. Due to its high melting point, molten copper metal is unlikely to occur in most fire situations. This metal is relatively non-toxic and poses little immediate hazard to personnel or the environment in an emergency situation.

Potential Health Effects: Inhalation of dust may result in irritation of the nasal mucous membranes. Inhalation of copper oxide fumes may cause irritation of the upper respiratory tract and may result in a form of metal fume fever, characterized by flu-like symptoms such as chills, fever, nausea, and vomiting. Ingestion of copper metal may cause metallic taste and gastrointestinal irritation. Copper particles embedded in the eye may cause redness, pain and discoloration of ocular tissue. Direct skin contact may result in irritation in some workers. Discoloration of the skin has been observed from handling copper, but does not indicate an actual injury. Copper is not listed as a carcinogen by OSHA, the NTP, the ACGIH, IARC, or the EU (see Toxicological Information, Section 11).

Potential Environmental Effects: Copper is relatively insoluble in water and, therefore, likely has low bioavailability. However, long-term exposure in aquatic and terrestrial environments or processing of the product can lead to the release of the constituent copper in more bioavailable forms. These bioavailable forms have the potential to yield toxic effects on aquatic organisms (see Ecological Information, Section 12).

SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS Registry No.	CONCENTRATION (% wgt/wgt)
Copper	7440-50-8	>99.9%

Note: See Section 8 for Occupational Exposure Guidelines.

SECTION 4. FIRST AID MEASURES

Eye Contact: *Symptoms: Mild eye irritation, redness.* Do not allow victim to rub eye(s). Let the eye(s) water naturally for a few minutes. If particle/dust does not dislodge, flush with lukewarm, gently flowing water for five minutes or until particle/dust is removed, while holding eyelid(s) open. If irritation persists, immediately obtain medical attention. DO NOT attempt to manually remove anything stuck to the eye, but rather seek immediate medical attention in this case.

Skin Contact: *Symptoms: Soiling of skin.* Dust: No health effects expected. If irritation does occur, flush with lukewarm, gently flowing water and mild soap for five minutes or until the product is removed. If skin irritation persists or if you feel unwell, obtain medical advice. Molten Metal: Flush contact area to solidify and cool but do not attempt to remove encrusted material or clothing. Cover burns and seek medical attention immediately.

Inhalation: *Symptoms: Coughing and irritation in heavy dust/fume clouds.* If symptoms are experienced, remove source of contamination or move victim from exposure area to fresh air. Get medical advice/attention if you feel unwell or are concerned. NOTE: Metal fume fever may develop 3-10 hours after exposure to copper fume. If symptoms of metal fume fever (flu-like symptoms) develop, obtain medical attention.

Ingestion: *Symptoms: Metallic taste, stomach upset.* Rinse mouth. If irritation or discomfort occurs, obtain medical advice.

SECTION 5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Massive metal is not considered a fire or explosion hazard. Finely-divided copper metal dust or powder has also been demonstrated to be non-flammable in laboratory testing. Explosions may occur however upon contact with certain incompatible materials (see Stability and Reactivity, Section 10).

Extinguishing Media: Use any means of extinction appropriate for the surrounding fire conditions such as water spray, carbon dioxide, dry chemical, or foam.

Fire Fighting: If possible, move solid materials from fire area. Cool any materials that are exposed to heat or flames by the application of water streams until well after the fire has been extinguished. Copper metal has a high melting point, and is unlikely to melt except in the most extreme fire conditions. If molten metal is present, do not use direct water streams on fires, due to the risk of a steam explosion that could potentially eject molten metal uncontrollably. Use a fine water mist on the front-running edge of the spill and on the top of the molten metal to cool and solidify it. Fire fighters must be fully trained and wear full protective clothing including an approved, self-contained breathing apparatus which supplies a positive air pressure within a full face piece mask.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Procedures for Cleanup: Control source of spillage if possible to do so safely. Clean up spilled material immediately, observing precautions in Section 8, Personal Protection. Molten metal should be allowed to cool and harden before cleanup. Once solidified wear gloves, pick up and return to process. Powder or dust should be cleaned up using methods which will minimize dust generation (e.g., vacuum solids, dampen material and shovel or wet sweep). Return uncontaminated spilled material to the process if possible. Place contaminated material in suitable labelled containers for later recovery in view of the commercial value of copper. Treat or dispose of waste material in accordance with all local, state/provincial, and national requirements.

Personal Precautions: Persons responding to an accidental release should wear protective clothing, gloves and a respirator in the event of a molten metal spill (see also Section 8). Close-fitting safety goggles may be necessary in some circumstances to prevent eye contact with dust and fume. Where molten metal is involved, wear heat-resistant gloves and suitable clothing for protection from hot-metal splash and radiant heat.

Environmental Precautions: Copper compounds, while not readily bioavailable in the environment, have the potential to pose ecological effects to aquatic life forms under certain chemical conditions. Releases of the product to water and soil should, therefore, be prevented.

SECTION 7. HANDLING AND STORAGE

Store copper in a dry, covered area. Copper cathodes suspected of containing moisture should be THOROUGHLY DRIED before being added to a molten bath. Cathodes may contain cavities that collect moisture. Entrained moisture will expand explosively when immersed in a molten bath and potentially spatter molten metal out of the bath.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Guidelines:

Component	ACGIH TLV	OSHA PEL	NIOSH REL
Copper (Dust)	1 mg Cu/m ³	1 mg Cu/m ³	1 mg Cu/m ³
Copper (Fume)	0.2 mg Cu/m ³	0.1 mg Cu/m ³	0.1 mg Cu/m ³

NOTE: OEGs for individual jurisdictions may differ from those given above. Check with local authorities for the applicable OEGs in your jurisdiction.

ACGIH - American Conference of Governmental Industrial Hygienists; OSHA - Occupational Safety and Health Administration; NIOSH - National Institute for Occupational Safety and Health. TLV – Threshold Limit Value, PEL – Permissible Exposure Limit, REL – Recommended Exposure Limit.

NOTE: The selection of the necessary level of engineering controls and personal protective equipment will vary depending upon the conditions of use and the potential for exposure. The following are therefore only general guidelines that may not fit all circumstances. Control measures to consider include:

Ventilation: Use adequate local or general ventilation to maintain the concentration of copper (as either dust or fumes) in the working environment well below recommended occupational exposure limits. Supply sufficient replacement air to make up for air removed by the exhaust system.

Protective Clothing: Gloves and coveralls or other work clothing are recommended to prevent prolonged or repeated direct skin contact when copper is processed. Appropriate eye protection should be worn where fume or dust is generated. Where hot or molten metal is handled, heat resistant gloves, goggles or face shield, and clothing to protect from hot metal splash and radiant heat should be worn. Safety type boots are recommended.

Respirators: Where copper dust or fumes are generated and cannot be controlled to within acceptable levels by engineering means, use appropriate NIOSH-approved respiratory protection equipment (a 42CFR84 Class N, R or P-95 particulate filter cartridge as a minimum).

General Hygiene Considerations: Always practice good personal hygiene. Refrain from eating, drinking, or smoking in work areas. Thoroughly wash hands before eating, drinking, or smoking in appropriate, designated areas.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Reddish metal	Odour: None	Odour Threshold: Not Applicable	pH: Not Applicable
Vapour Pressure: 1 mm Hg at 1083°C Negligible @ 20°C	Vapour Density: Not Applicable	Melting Point/Range: 1083°C	Boiling Point/Range: 2595°C
Relative Density (Water = 1): 8.94	Evaporation Rate: Not Applicable	Coefficient of Water/Oil Distribution: Not Applicable	Solubility: Insoluble in water
Flash Point: None	Flammable Limits (LEL/UEL): Not Flammable	Auto-ignition Temperature: None	Decomposition Temperature: None

SECTION 10. STABILITY AND REACTIVITY

Stability & Reactivity: Copper is stable and not considered reactive under normal temperatures and pressures. Hazardous polymerization or runaway reactions will not occur.

Incompatibilities: Copper is incompatible with nitric acid, acetylene, chlorine, fluorine, chlorine trifluoride, and peroxides. Shock-sensitive compounds are formed with acetylenic compounds, ethylene oxide or azide compounds. Copper in finely-divided powder or granular form reacts with strong oxidants like chlorates, bromates, iodates and ammonium nitrate causing a potential explosion hazard.

Hazardous Decomposition Products: High temperature operations such as oxy-acetylene cutting, electric arc welding, arc-air gouging or overheating a molten metal bath may generate copper fumes. These fumes will contain copper oxides, which, on inhalation in sufficient quantity, can produce metal fume fever.

SECTION 11. TOXICOLOGICAL INFORMATION

General: Copper is an essential element, but can become toxic when inhaled or ingested in large doses. Most reports of acute toxicity are from suicidal attempts involving ingestion of copper sulphate. Individuals with a rare disorder called "Wilson's Disease" (estimated prevalence 0.003% of the population) are predisposed to accumulate copper and should not be occupationally exposed. However, in the form in which this product is sold it is relatively non-toxic. The major route of exposure would be through the generation and inhalation of copper oxide fume.

Acute:

Skin: Copper metal is not irritating to skin other than by direct abrasive action of metal particles on skin tissue.

Eye: Contact with dust or fume may cause local irritation. Embedded copper particles in the eye result in a brownish or green-brown discoloration of the cornea, lens and iris (chalcosis) which may progress to serious ocular complications.

Inhalation: Copper dust may be irritating to the nasal passages and the throat with a sweetish, metallic taste and excessive salivation. An intense, short-term exposure to copper fumes from cutting or welding, etc. could result in the condition called metal fume fever. The symptoms of metal fume fever generally occur within 3 to 10 hours. They may include immediate dryness and irritation of the throat, metallic taste, tightness of the chest, and coughing that may later be followed by flu-like symptoms of fever, malaise, perspiration, frontal headache, muscle cramps, low back pain, occasionally blurred vision, nausea, and vomiting. Those experiencing a single acute episode of metal fume fever generally recover slowly but without apparent residual effects.

Ingestion: Ingestion of copper metal may cause metallic taste and gastrointestinal irritation. Individuals reported to have ingested large quantities of copper salts have reported gastrointestinal effects including vomiting, diarrhea, nausea, malaise, anorexia, abdominal pain and a metallic taste in the mouth. Effects on the kidneys and liver, and even death have also been reported in severe cases of copper poisoning from ingesting soluble copper salts. However, copper is a strong emetic and spontaneous vomiting following ingestion usually limits uptake of copper.

Chronic: Prolonged exposure to copper dust or fume can cause irritation to the eye and skin. A green discoloration of the skin has been reported similar to that sometimes experienced from copper jewelry. This green discoloration may occasionally also be seen in hair (particularly notable in blonde hair), nails and teeth. A few instances of allergic contact dermatitis have been reported. Copper is not listed as a human carcinogen by the Occupational Safety and Health Administration (OSHA), the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC), the American Conference of Governmental Industrial Hygienists (ACGIH) or the European Union (EU).

Animal Toxicity:

<u>Hazardous Ingredient:</u>	<u>Acute Oral Toxicity:</u>	<u>Acute Dermal Toxicity:</u>	<u>Acute Inhalation Toxicity:</u>
Copper † LD ₅₀ , Mouse, Oral,	>5,000 mg/kg [†] ‡ LC ₅₀ , Rat, Inhalation, 4 hour	>2,000 mg/kg* * LD ₅₀ , Mouse, Dermal	>5.11 mg/L [‡]

SECTION 12. ECOLOGICAL INFORMATION

Copper metal is relatively insoluble in water and, therefore, generally has low bioavailability. However, long-term exposure in aquatic and terrestrial environments or processing of the product can lead to the release of the constituent copper in more bioavailable forms. These more bioavailable forms have the potential to yield toxic effects under specific chemical conditions (e.g., low pH). The mobility of the copper compounds in soluble forms is also media-dependent. They can bind with inorganic and organic ligands, reducing their mobility and bioavailability in both soil and water. Bioavailability is also regulated by other factors in the aquatic environment, such as hardness and dissolved organic carbon content.

SECTION 13. DISPOSAL CONSIDERATIONS

If material cannot be returned to process or salvage, dispose of in accordance with applicable regulations.

SECTION 14. TRANSPORT INFORMATION

No special shipping or transportation requirements in ingot form.

SECTION 15. REGULATORY INFORMATION

U.S.

INGREDIENTS LISTED ON TSCA INVENTORY..... Yes

HAZARDOUS UNDER HAZARD COMMUNICATION STANDARD..... No (CFR 1910.1200, revised March 26, 2012)

CERCLA SECTION 103 HAZARDOUS SUBSTANCES YesRQ: 5,000 lbs. (2270 kg.)*
*reporting not required when diameter of the pieces of solid metal released is equal to or exceeds 100 micrometers (0.004 inches).

EPCRA SECTION 302 EXTREMELY HAZARDOUS SUBSTANCE No

EPCRA SECTION 311/312 HAZARD CATEGORIES No Hazard Categories Apply

EPCRA SECTION 313 TOXIC RELEASE INVENTORY:..... Copper.....CAS No. 7440-50-8
Percent by Weight - At least 99%

SECTION 16. OTHER INFORMATION

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Date of Latest Revision:

The information in this Safety Data Sheet is based on the following references:

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- American Conference of Governmental Industrial Hygienists, 2015, Guide to Occupational Exposure Values.
- BIA Report 13/97 – Combustion and Explosion Characteristics of Dusts – Table 2 Product Group: Metals and Alloys.
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- Commission de la santé et la sécurité du travail, Service du répertoire toxicologique, Cuivre , 2010-07.
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- Toxicology of the Eye, 2nd Ed. W. Morton Grant, MD, Charles C. Thomas , Publishers; Springfield. IL (1974).
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- U.S. Dept of Health and Human Services, National Institute for Occupational Safety and Health, NIOSH Pocket Guide to Chemical Hazards. CD-ROM Edition September 2005.
- U.S. Dept of Health and Human Services, National Institute for Occupational Safety and Health, Registry of Toxic Effects of Chemical Substances (RTECS) CCOHS Web Access subscription.
- U.S. Occupational Safety and Health Administration, 1989, Code of Federal Regulations, Title 29, Part 1910.

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