



MATERIAL SAFETY DATA SHEET
June 1, 2006

Product name: Silver Paste Plus™ Silver Paste
Part Number: SU-900-AGP

The ultimate conductive adhesive for SEM and high Tc thin film superconductor applications

Explanation of Hazardous Labels Silver metal properties

Chemical Symbol: Ag
CAS #: 7440-22-4
Atomic Number: 47
Atomic Weight: 107.8682
Color: Silver
Melting Point: 961.78°C (1763.2°F)

Silver Paste Plus is a high purity, uniform, viscous silver particle suspension, ideal for SEM use, especially for the mounting of porous samples where capillary action would be a problem. Although this product requires a longer drying time than all other silver paint products, its very high conductivity and absence of "wicking" into porous samples makes it the mounting medium of choice for many SEM laboratories worldwide.

Silver Paste Plus is packaged in a metal squeeze tube for ease of handling, convenient application, and long shelf life after first use. Unlike products packaged in a wide mouth jar, the Silver Paste Plus will not dry out into a hard "brick" after just a few uses.

High temperature limits: Although the melting point of silver metal is reported to be 961.78°C (1763.2°F), from a practical standpoint, one never comes close to this temperature in terms of use, because in addition to the well known oxidation and sulfiding that occurs when heated in air, what is not generally known is that even in vacuum, the metal starts to sublime on the order of 400°C (752°F) and by 500°C (932°F), the sublimation rate is sufficiently great that one can not go higher without running the risk of causing problems to their vacuum system (some would say this critical temperature is lower).

Storage Conditions: Room temperature



SECTION 01: IDENTIFICATION

Date Effective:
August 14, 2000
(most recent revision)

Chemical Name/Synonyms: Mixture

Chemical family: Silver colloid in carrier with polymer

Main use:

Mounting of samples for scanning electron microscopy; mounting of silicon wafers when producing high temperature thin film superconductor materials.

Secondary use:

PC board repairs and other electronic industry applications.

SECTION 02: COMPOSITION

Carcinogenicity:

CAS #	Chemical Name	V.P. mm Hg@20°C	Weight %
100-65-6	1-methoxy-2-propanol acetate	3.7	10-30
112-07-2	ethylene glycol monobutyl ether acetate	< 1	0.1-1
7440-22-4	silver, metallic		> 60
Not known	Fatty acid derivative		0.1-1
65859-05-4	Acrylic resin		5-10
	Proprietary ingredients(s)		0.1-1

SECTION 03: PHYSICAL AND CHEMICAL PROPERTIES - HAZARDS OVERVIEW

Instability:

The product is normally stable.

Incompatibility:

Avoid contact with oxidizing agents, acetylene, ammonia, hydrogen peroxide, chlorine trifluoride, nitric acid, ethanol, strong bases, strong acids, strong oxidizing agents, ethylenimine, oxalic acid, tartaric acid, bromoazide.

**Decomposition:**

Decomposition products: Carbon dioxide, metal fumes, metal oxides, carbon monoxide, ethyl methacrylate, water, and methyl acrylate

Polymerization:

This product does not normally polymerize significantly.

SECTION 04: FIRE AND EXPLOSION DATA

Flashpoint: 50.5°C (123 °F) Closed Cup
53.3°C (128 °F) Seta Closed Cup

Fire and Explosion Hazards:

Keep away from sparks and open flames! Do not smoke in area with open product; if there is a chance of the product being heated above its flash point during processing, remove all sources of ignition such as open sparks, flames or static discharge to prevent vapor ignition.

Extinguishing Media:

Water spray, dry chemical, or carbon dioxide.

Special Fire fighting Information:

Toxic decomposition products may form under fire conditions (See decomposition section). Wear full protective clothing and a full face piece, positive pressure, self-contained breathing apparatus (SCBA); Decontaminate contaminated clothing and equipment with soap and water. Dispose of residues per federal, state, and local regulation (See waste disposal section).

SECTION 05: HEALTH HAZARD INFORMATION**Overview:**

The most likely route of overexposure to components of this product is inhalation. During room temperature use, such as dispensing and screen printing, or even application to specimens being prepared for SEM examination, volatile solvents and organics will start evaporating. During drying (some might say "curing", but which is a technically incorrect description) at 100-150 °C (212 - 302 °F), most of the volatile solvents and organics will evaporate. Some low volatility organics will start to evaporate. During firing, 600-900°C, all remaining organics will burn off. Small quantities of nonrefractory metals and metal oxides, such as lead or cadmium, if present in the product may vaporize to rapidly recondense outside the high temperature regions of the furnace. Laser trimming resistors can also volatilize small amounts of metals and metal oxides. Personal performing maintenance/repairs on furnaces, filters or ducts may need respirators for protection from accumulated respirable metal oxides. Overexposure to other chemicals used in the operation should be considered also, such as cleaning solvents used in screen printing and dispensing. A well designed area and personal air sampling and analysis can show if exposures are within established limits. Well designed local ventilation and process enclosures, such as for ovens,



furnaces, lasers, and screen printers, are effective ways to limit employee exposure where needed.

In addition to meeting exposure limits, it is always prudent to use all practical means to limit employee exposure to all chemicals. A significant difference in overall exposure can be made by practical measures such as:

Inhalation:

Minimizing by keeping the tubes and/or tins of this product and solvent and waste disposal containers of solvent damp wipes tightly closed.

Skin:

Avoiding contact by using proper gloves

Ingestion:

Avoiding by washing hands before eating, drinking or smoking, and restricting these activities to outside the work area.

Eyes:

Avoiding contact by wearing chemical splash goggles where there is a splash potential.

SECTION 06: HAZARDS IDENTIFICATION - PRINCIPAL HEALTH EFFECTS

1-methoxy-2-propanol acetate

Toxic effects described in animals include:

Skin or eye contact: Mild skin irritation, eye irritation.

Toxic effects of repeated or prolonged animal exposures include:

By skin or eye contact: Skin effects

By inhalation:

Respiratory effects; degeneration of the olfactory epithelium; renal effects; disturbed equilibrium; nonspecific effects, that is, weight loss and irritation; Liver effects;

Additional animal tests have shown no genetic damage in bacterial or mammalian cell cultures, no developmental toxicity

Human health effects of overexposure may include:

1. By skin or eye contact:

Skin irritation with discomfort or rash; eye irritation with discomfort, tearing, or blurring of vision.

2. By inhalation:



Nonspecific discomfort, that is, nausea, headache or weakness.

Human effects of higher level acute, repeated or chronic overexposure may include:

3. By inhalation:

Irritation of the upper respiratory passages with coughing and discomfort.

Also: Animal tests indicate commercial grade 1-methoxy-2-propanol acetate does not cause developmental toxicity. However, tests of pure 2-methoxy-1-propanol acetate in rabbits and rats by inhalation have shown developmental toxicity. 2-methoxy-1-propanol acetate did not show developmental toxicity by skin contact. 2-methoxy-1-propanol acetate is present in commercial grade 1-methoxy-2-propanol acetate in low concentrations.

Ethylene glycol monobutyl ether acetate:

Additional animal tests have shown:

Developmental toxicity at dosage levels showing maternal toxicity; no animal data available to define carcinogenicity.

Human health effects of over exposure may include:

1. By skin contact:

May cause irritation, redness or itching; skin permeation can occur in amounts capable of producing effects of systemic toxicity.

2. By eye contact:

Eye irritation with discomfort, tearing, or blurring of vision.

3. By inhalation:

Irritation of the nose and throat and of the upper respiratory passages.

4. By ingestion:

No known or anticipated toxic effects.

By inhalation or ingestion:

Central nervous system depression with dizziness, confusion, uncoordinated, drowsiness, or unconsciousness; headache; difficulty in breathing; nausea; blood in urine; red blood cell destruction.

Human effects of higher level acute, repeated, or chronic exposure may include:

By inhalation or ingestion:

Abnormal blood-forming system function with anemia; liver damage; abnormal kidney function as detected by laboratory tests; kidney damage; coma or fatality from gross overexposure.

Fatty Acid Derivative: No information



Silver (Metallic):

Additional animal studies have shown:

Genetic damage in mammalian cell cultures; no genetic damage in bacterial cell cultures; no animal test reports are available to define carcinogenic, developmental, or reproductive hazards.

Human health effects of overexposure may include:

1. By skin contact: May cause irritation

2. By eye contact:

May cause irritation; photophobia

1. By inhalation or contact:

Argyria, a blue-gray discoloration of the skin, mucous membranes, inner surface of the eyelids, cornea, or lens.

Human effects of higher level acute, repeated or chronic overexposure may include:

1. By inhalation or contact:

Argyria

In addition: There is no effective treatment for argyria. Cases of argyria have not resulted from exposure to silver concentrations in air of less than 0.01 mg/m³.

Acrylic resin:

Toxic effects described in animals include:

Slight skin irritation; slight eye irritation.

Human health effects of overexposure may include:

Nonspecific discomfort, e.g. nausea, headache, or weakness; eye irritation with discomfort, tearing or blurring of vision; irritation of the upper respiratory passages; allergic skin rashes; dizziness.

Proprietary ingredients:

Human health effects of overexposure may include:

1. By skin contact:

May irritate skin

2. By eye contact:

Eye irritation with discomfort, tearing, or blurring of vision.



3. By inhalation:

Irritation of the upper respiratory passages.

Individuals may have increased susceptibility to the hazards of overexposure to ingredient(s) of this product if they have pre-existing diseases of the skin, central nervous system, eyes, spleen, lungs, liver, and kidneys.

Animal Data:

1-Methoxy-2-Propanol Acetate

Skin absorption LD50: 5,000 mg/kg in rabbits

Oral LD50: 8,532 mg/kg in female rats

Ethylene Glycol Monobutyl Ether Acetate

Inhalation 4 hour ALC: > 400 ppm in rats

Skin absorption LD50: 1,500 mg/kg in rabbits

Oral LD50: 2,400-3000 mg/kg in rats

Fatty acid derivative

No information found

Silver (metallic)

Oral LD50 (mice): > 10 g/kg

Acrylic resin

Inhalation 1 hour LC50: 2 mg/L in rats

Skin absorption LD50: >3000 mg/kg in rabbits

Oral LD50: > 5000 mg/kg in rats

Proprietary ingredient(s)

Intravenous mouse LD50: 152 mg/kg

Free acid Oral LD50 (Rat): 64 ml/kg

Carcinogenicity listing:

No ingredients of this product are designated by IARC, NTP, OSHA, ACGIH as potential carcinogens.

Exposure limits:

Work place exposures should be kept below the following limits:

	AIHA 8 hr 15 min	ACGIH 8 hr 15 min	OSHA 8 hr 15 min
Name/Units			
Methyl acrylate/ppm	10s	10s	
Metallic silver/mg/m3	0.1	0.01	



Particulates, N.O.S.,

respirable/mg/m ³	5		
Particulates, N.O.S., total/mg/m ³		10	15
Propylene glycol monomethyl ether acetate/mg/m ³			541

Notes on exposure limits:

PELs:

OSHA Permissible Exposure Limits - 29 CFR 1910.1000, Subpart Z, or specific substance standards.

TLVs:

ACGIH Threshold Limit Values - published by American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Cincinnati, OH 45211 USA

WEELs:

AIHA Workplace Environmental Exposure Limits - published by the American Industrial Hygiene Association, 2700 Prosperity Avenue, Suite 250, Fairfax, VA 22031

SECTION 07: FIRST AID INSTRUCTIONS

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash contaminated clothing before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

Inhalation:

If inhaled, remove to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

If swallowed, immediately give two glasses of water and induce vomiting. Never give anything by mouth to an unconscious person. Call a physician immediately.

SECTION 08: PROTECTION INFORMATION

Adequate local ventilation should be used to keep exposures below applicable limits. Other engineering controls such as totally enclosed handling systems are also preferred. Respiratory protection will be needed if exposures can not be kept below applicable limits by other means.

Respiratory protection:



If respirators are needed to meet applicable limits, a respiratory protection program up to the level of OSHA Standard 29 CFR 1910.134 is mandatory. This includes air monitoring, selection, medical approval, training, fit testing, inspection, maintenance, cleaning, storage, etc. Selection of a suitable respirator will depend on the properties of the contaminant(s) and their actual or expected air concentration(s) vs. applicable limits. Consult ANSI Standard Z88.2 for decision logic to select appropriate NIOSH/MESA approved respirators.

Respirators with organic vapor cartridges provide adequate protection, within use limitations, for the following components in this product: Toluene

Gloves:

Gloves should be used when the possibility of skin contact exists; the suitability of a particular glove and glove material should be determined as part of an overall glove program. Considerations may include chemical breakdown time, permeation rate, abrasion, cut and puncture resistance, flexibility, duration of contact, etc.

Recommended glove materials:

NBR (nitrile-butadiene rubber), polyethylene or vinyl for very limited exposure based on reported experiences. Because the product is a complex mixture and formulated composition, glove testing may be appropriate as part of the glove selection process.

Other protection practices:

Appropriate eye protection such as chemical splash goggles should be used if the possibility of eye contact exists; protective outer clothing should be used where the possibility of body contact exists. Contaminated work clothing should not be allowed out of the workplace. Do not smoke, consume or store food or drinks in areas where the product is handled and stored. After handling the product, wash hands thoroughly before leaving the work area.

Additional engineering controls, work practices, and training may be required depending on exposure levels. There are discussed in OSHA Respiratory Protection Standard (29CFR 1910.134) and OSHA Hazard Communication Standard (29 CFR 1910.1200).

Do not breathe dust. Avoid contact with eyes, skin, or clothing. Wash thoroughly after handling.

SECTION 09: DISPOSAL INFORMATION

Spill, leak, or release:

For small spills:

Absorb on rags, sand or other absorbent material.

For large spills:

Get workers out of the affected area. If flammable liquids or vapors may be present, turn off electrical devices or other sources of sparks or flames. Wear protective equipment. Use supplied-air respiratory protection if vapor concentrations are not known. Contain spill at source by diking



or absorbing with sand. Do not allow spill to spread to or intentionally flush to sewer or ground. Wash area thoroughly. Adequately ventilate area; spill residue, cleaning rags and absorbant may be refined to recover the precious metal content.

Waste disposal:

Components of this product may be considered hazardous; waste product may be refined to recover precious metal content.

SECTION 10: PRODUCT INFORMATION

Contaminated Items:

Empty product containers, contaminated clothing and cleaning materials, etc. should be considered hazardous until decontaminated or properly disposed of. See Waste Disposal Section.

SECTION 11: ADDITIONAL TOXICOLOGICAL INFORMATION

No further information known.

SECTION 12: ECOLOGICAL INFORMATION

Exotoxicity: Exotoxicity is expected to be low based on the relatively tiny amounts used in each product put up.

Environmental Fate: No information found in our selected references.

Bioaccumulation: Not expected to occur.

SECTION 13: TRANSPORT INFORMATION

Shipping information:

Shipping name: Flammable Liquid, N.O.S.(1-Methoxy-2-Propanol Acetate)

DOT Hazard Class: Flammable Liquid 3

UN/NA ID: UN-1993

Packing Group: II

Marine Pollutant: Not known



SECTION 14: REGULATORY INFORMATION

TSCA: All components of this product are listed on the TSCA 8(b) inventory. If identified components of this product are listed under the TSCA 12(b) Export Notification Rule, they will be listed below.

TSCA 12(b) Component listed under TSCA Section

SARA-Title 3, Section 313 Emissions Reporting Information (40 CFR 372)

This product contains a chemical which is listed in Section 313 at, or above, the minimum concentrations. The following listed chemicals are present:

CAS Number	Description	%
7440-22-4	Metallic Silver	> 60

California Prop. 65:

Proposition 65 requires manufacturers or distributors of consumer products into the State of California to provide a warning statement if the product contains ingredients for which the State has found to cause cancer, birth defects or other reproductive harm. If this product contains an ingredient listed by the State of California to cause cancer or reproductive toxicity, it will be listed below:

Ingredient(s)/CAS#	Weight %
Toluene / 108-88-3	< 0.1

This product is a physical mixture. The health effects information about this product is based on the individual ingredients. The data in this Materials Safety Data Sheet (MSDS) relates only to the specific product designated herein and does not relate to its use in combination with any other material or in any process.

Canadian WHMIS Classification: Class B, Div. 3; D2B

SECTION 15: OTHER INFORMATION

If this product should be used in ways that are outside of the intended applications in scanning electron microscope laboratories, and if it is going to be formulated into some other system, so that it becomes just another component of that other system, read the MSDS sheets for the other components before blending as the resulting mixture may have the hazards of all of its parts.

Disclaimer of Liability:

Caution! Do not use materials in applications involving implantation within the body; direct or indirect contact with the blood pathway; contact with bone, tissue, tissue fluid, or blood; or prolonged contact with mucous membranes. Products are not designed or manufactured for use



in implantation in the human body or in contact with internal body fluids or tissues. US, Inc. will not provide to customers making devices for such applications any notice, certification, or information necessary for such medical device use required by US FDA (Food and Drug Administration) regulation or any other statute. US, Inc. make no representation, promise, express warranty or implied warranty concerning the suitability of these materials for use in implantation in the human body or in contact with internal body tissues of fluids.