MATERIAL SAFETY DATA SHEET

1. Identification of the substance or mixture and of the supplier

A. GHS product identifier Gold Wire
B. Recommended use of the chemical and restrictions on use
Recommended use Bonding, Bumping. (Integrate circuit, TR, LED etc.)
Restrictions on use Not available
C. Supplier
Company name MK ELECTRON CO.,LTD
Address 316-2, Kumeu-ri, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-812, Korea
Emergency phone number Tel: 82-031-330-1900
Respondent Not available
Fax 82-031-338-6817

2. Hazards identification

A. GHS classification of the substance/mixture
Hazardous to the aquatic environment (acute hazard) : Category 3
B. GHS label elements, including precautionary statements
Pictogram and symbol : Not applicable
Signal word : Not applicable
Hazard statements :
H402 Harmful to aquatic life.
Precautionary statements
Precaution
P273 Avoid release to the environment.
Treatment : Not applicable
Storage : Not applicable
Disposal
P501 Dispose the contents/container in accordance with local/regional/national/international regulations.
C. Other hazard information not included in hazard classification (NFPA)
Health 0
Flammability Not available
Reactivity Not available

3. Composition/information on ingredients

Products Item	Type of Gold Bonding Wire	Name	CAS No.	Contents (%)
Gold Wire (4N)	L (Low loop wire)	Gold	7440-57-5	Min99.99%
		Beryllium	7440-41-7	Max0.0008%
		Calcium	7440-70-2	Max0.0005%
	T (Long loop wire)	Gold	7440-57-5	Min99.99%
		Beryllium	7440-41-7	Max0.0008%
		Calcium	7440-70-2	Max0.0005%
	M (Normal Loop)	Gold	7440-57-5	Min99.99%
		Beryllium	7440-41-7	Max0.0008%
	UB(Super long loop wire)	Gold	7440-57-5	Min99.99%
		Beryllium	7440-41-7	Max0.0008%

		Calcium	7440-70-2	0.0013~0.0018%
	SU	Gold	7440-57-5	Min99.99%
		Beryllium	7440-41-7	Max0.0008%
		Calcium	7440-70-2	0.0013~0.0018%
	UC(Super long loop wire)	Gold	7440-57-5	Min99.99%
		Beryllium	7440-41-7	Max0.0008%
		Calcium	7440-70-2	0.0013~0.0018%
	UN(Super Low Loop wire)	Gold	7440-57-5	Min99.99%
		Calcium	7440-70-2	Max0.004%
	N2	Gold	7440-57-5	Min99.99%
		Calcium	7440-70-2	Max0.004%
	HR Type	Gold	7440-57-5	Min99.99%
		Calcium	7440-70-2	Max0.004%
	XC(Ultra low loop wire)	Gold	7440-57-5	Min99.99%
		Calcium	7440-70-2	0.0020~0.0025%
	UL(4N High strength wire)	Gold	7440-57-5	Min99.99%
		Beryllium	7440-41-7	Max0.0008%
		Calcium	7440-70-2	Max0.003%
Gold Wire (3N)	UR Type	Gold	7440-57-5	Min99.982%
		Palladium	7440-05-3	Min0.01%
		Calcium	7440-70-2	Min0.004%
	UR2 Type	Gold	7440-57-5	Min99.94%
		Palladium	7440-05-3	Min0.05%
		Lanthanum	7439-91-0	Max0.002%
		Calcium	7440-70-2	Min0.004%
Gold Wire (2N)	R(Alloy High Strength wire)	Gold	7440-57-5	Min99%
		Palladium	7440-05-3	0.95±0.05%
		Calcium	7440-70-2	Max0.002%
	LK(Advanced 2N wire)	Gold	7440-57-5	Min98.99%
		Palladium	7440-05-3	Max0.3%
		Calcium	7440-70-2	Max0.003%
	UP Type	Gold	7440-57-5	Min 99%
		Platinum	7440-06-4	Max 0.8%
		Palladium	7440-05-3	0.20±0.05%
		Calcium	7440-70-2	Max0.002%

4. First aid measures

A. Eye contact

- Call emergency medical service.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.

B. Skin contact

- Call emergency medical service.

- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.

C. Inhalation

- Move victim to fresh air.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.

D. Ingestion

- Call emergency medical service.

E. Indication of immediate medical attention and notes for physician

- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

5. Fire fighting measures

A. Suitable (and unsuitable) extinguishing media

- Suitable extinguishing media: Dry sand, dry chemical, alcohol-resistant foam, water spray, regular foam, CO_2
- Unsuitable extinguishing media: High pressure water streams

B. Specific hazards arising from the chemical

- May be ignited by heat, sparks or flames.
- Containers may explode when heated.
- Some of these materials may burn, but none ignite readily.
- Fire will produce irritating and/or toxic gases.
- If inhaled, may be harmful.

C. Special protective equipment and precautions for fire-fighters

- Dike fire-control water for later disposal; do not scatter the material.
- Move containers from fire area if you can do it without risk.
- Fire involving Tanks; Cool containers with flooding quantities of water until well after fire is out.
- Fire involving Tanks; Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- Fire involving Tanks; Always stay away from tanks engulfed in fire.

6. Accidental release measures

A. Personal precautions, protective equipment and emergency procedures

- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent dust cloud.
- Please note that there are materials and conditions to avoid.

B. Environmental precautions and protective procedures

- Prevent entry into waterways, sewers, basements or confined areas.

C. The methods of purification and removal

- Large Spill; Dike far ahead of liquid spill for later disposal.
- With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
- Powder Spill; Cover powder spill with plastic sheet or tarp to minimize spreading and keep powder dry.
- Small Spill; Take up with sand or other non-combustible absorbent material and place into containers for later disposal.

7. Handling and storage

A. Precautions for safe handling

- Please note that materials and conditions to avoid.

- Wash thoroughly after handling.
- Please work with reference to engineering controls and personal protective equipment.
- Be careful to high temperature.

B. Conditions for safe storage

- Store in a closed container.
- Store in cool and dry place.

8. Exposure controls/personal protection

A. Occupational Exposure limits

Korea regulation

Beryllium TWA = 0.002 mg/m³ STEL = 0.01 mg/m³
Platinum TWA = 0.002 mg/m³

ACGIH regulation

Beryllium TWA = 0.00005 mg/m³
Platinum TWA = 1 mg/m³

Biological exposure index : Not available

OSHA regulation

Beryllium TWA = 2μg/m³ STEL = 25μg/m³
Platinum TWA = 0.002 mg/m³

NIOSH regulation

Beryllium Ceiling = 0.0005 mg/m³
Platinum TWA = 1 mg/m³

EU regulation

Platinum TWA = 1 mg/m³

Other

Beryllium Finland:TWA=0.001mg/m³ France:TWA=0.002mg/m³ Greece:TWA=0.005mg/m³ Hongkong:TWA=0.002mg/m³ Ireland:TWA=0.00005mg/m³
Platinum U.S : TWA = 1mg/m³, STEL = 3mg/m³ Austrilia : TWA = 1mg/m³ Canada : TWA = 1mg/m³ United kingdom : TWA = 5mg/m³ Spain : TWA = 1mg/m³

B. Appropriate engineering controls

- Provide local exhaust ventilation system or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

C. Personal protective equipment

Respiratory protection

- Wear NIOSH or European Standard EN 149 approved full or half face piece (with goggles) respiratory protective equipment when necessary.
- In case exposed to particulate material, the respiratory protective equipments as follow are recommended. ;facepiece filtering respirator or air-purifying respirator, high-efficiency particulate air(HEPA) filter media or respirator equipped with powered fan, filter media of use(dust, mist, fume)
- In lack of oxygen(< 19.5%), wear the supplied-air respirator or self-contained breathing apparatus.oxygen

Eye protection

- Wear facepiece with goggles to protect.
- An eye wash unit and safety shower station should be available nearby work place.
- Wear breathable safety goggles to protect from particulate material causing eye irritation or other disorder.
- An eye wash unit and safety shower station should be available nearby work place.

Hand protection

- Wear chemical resistant gloves.
- Wear appropriate protective gloves by considering physical and chemical properties of chemicals.

Body protection

- Wear appropriate protective chemical resistant clothing.
- Wear appropriate protective clothing by considering physical and chemical properties of chemicals.

9. Physical and chemical properties

A. Appearance	Wire (gold)
B. Odour	Odorless
C. Odour threshold	Not available
D. pH	Not applicable
E. Melting point/Freezing point	1065℃ (1949°F)
F. Initial boiling point and boiling range	2700℃ (4892°F)
G. Flash point	Not available
H. Evaporation rate	Not applicable
I. Flammability (solid, gas)	Non-flammable as a solid
J. Upper/lower flammability or explosive limits	Not available
K. Vapor pressure	1mmHg at 1869℃
L. Solubility	Water solubility: insoluble Soluble: aqua regia, a high temperature sulphuric acid, potassium cyanide, Insoluble: acid, alkali
M. Vapor density	Not applicable
N. Relative density	19.31
O. Partition coefficient(n-octanol/water)	Not available
P. Auto-ignition temperature	Not available
Q. Decomposition temperature	Not available
R. Viscosity	Not available
S. Formula mass	196.97g/mol

10. Stability and reactivity

A. Chemical stability and Possibility of hazardous reactions:
- This product is stable at normal temperatures and pressure.

B. Conditions to avoid:
- Heat, sparks or flames
- Avoid excess dust generation.

C. Incompatible materials:
- Combustibles
- Acid, base, oxidizing agents, halogens, hydrogen peroxide, cyanides

D. Hazardous decomposition products:
- Irritating and/or toxic gases

11. Toxicological information

A. Information of Health Hazardous:

Acute toxicity

Oral [Not classified]

- **Beryllium** : Rat LD_{50} > 2,000 mg/kg (OECD TG 423, GLP)(female), (One year results orally administered beryllium, poultry increased bone fractures, liver hemorrhage, splenomegaly, peritonitis and other symptoms appeared.)
- **Calcium** : Rat LD_{50} > 2,000 mg/kg (female)(OECD TG 425, GLP, read-across ; CAS No. 1305-62-0)

Dermal [Not classified]

- **Calcium** : Rabbit LD_{50} > 2,500 mg/kg (OECD TG 402, GLP, read-across ; CAS No. 1305-62-0)

Inhalation [Not classified]

- **Beryllium** : (ECHA: Category 2, the classification is not sufficient evidence)

Skin corrosion/ irritation [Not classified]

- **Beryllium** : In skin irritation test with rabbits, skin irritations were not observed.(OECD TG 404, GLP),(ECHA: Category 2, the classification is not sufficient evidence)
- **Calcium** : Irritating to skin, eyes, and respiratory system.
- **Platinum** : Contact can irritate the skin.

Serious eye damage/ irritation [Not classified]

- **Beryllium** : In eye irritation test with rabbits, eye irritations were not observed.(OECD TG 405, GLP),(ECHA: Category 2, the classification is not sufficient evidence)
- **Calcium** : Irritating to skin, eyes, and respiratory system.
- **Platinum** : Rednes and Pain were observed

Respiratory sensitization [Not classified]

- Platinum : May cause an asthma-like allergy.

Skin sensitization [Not classified]

- **Beryllium** : In skin sensitization test with guinea pigs, skin sensitization was not observed.(OECD TG 406, GLP)(male),(ECHA: Category 1, the classification is not sufficient evidence)
- **Platinum** : May cause a skin allergy.

Carcinogenicity [Not classified]

IARC

- **Beryllium** : Group 1

NTP

- **Beryllium** : K

ACGIH

- **Beryllium** : A1

KOREA-ISHL

- **Beryllium** : 1A

EU

- **Beryllium** : 2

Gold : Powdered gold is not oncogenic in rats, while implanted small sheets of gold induced tumors.

Beryllium : EPA : B1

Mutagenicity [Not classified]

- **Beryllium** : Negative reactions were observed with and without metabolic activation in vitro mammalian cell gene mutation assay(OECD TG 476, GLP), bacterial reverse mutation assay(OECD TG 471, GLP), (OECD Draft Proposal, GLP), DNA Damage and Repair, Unscheduled DNA Synthesis in Mammalian Cells In Vitro(OECD TG 482, GLP)(mammalian chromosome aberration test(OECD TG 473, GLP).
- **Palladium** : Palladium applied in its metallic form showed no cytotoxicity in mouse fibroblasts or little cytotoxicity in human cell lines, as evaluated microscopically.

Reproductive toxicity [Not classified]

- **Lanthanum** : Maternal toxicity with reduced body weight gain and food consumption was observed.Test material related adverse developmental toxicity was not observed. (read-across; CAS no.587-26-8,OECD TG 414) No test substance related changes were observed for the mean numbers of corpora lutea, implantations, live fetuses, pre- and postimplantation losses.(read-across; CAS no.587-26-8,OECD TG 415)
- **Platinum** : There is no evidence that platium affects reproduction.

Specific target organ toxicity (single exposure) [Not classified]

- **Beryllium** : In general, the total number of cells in rats, white blood cell count, protein content, such as lung damage appears.
- **Calcium** : In acute oral toxicity test with female rats, reversible signs were

seen(hunched posture, slight sedation, deep respiration). Irritating to skin, eyes, and respiratory system.
- **Palladium** : Six months after a single intratracheal application of palladium dust, several histopathological signs of inflammation were noted in the lungs of rats.

Specific target organ toxicity (repeat exposure) [Not classified]

- **Beryllium** : (ECHA: Category 1, the classification is not sufficient evidence)
- **Palladium** : Palladium metal was administered to rats at 5 ppm/day in drinking water for whole lifespan. Effects observed include: Increased number of malignant pulmonary tumors classified as lymphomas.
- **Lanthanum** : Loss of hair and increased numbers of leucocytes were observed.But significant histopathologic findings were not observed.(read-across)(OECD TG 408)

Aspiration Hazard [Not available]

12. Ecological information

A. Ecological toxicity

- Acute toxicity : [Category 3]
- Chronic toxicity : [Not classified]

Fish Not available

crustacean

- **Calcium :** 48hr-EC_{50} (*Daphnia magna*) = 49.1 mg/L (OECD TG 202, GLP, read-across ; CAS No. 1305-62-0), 14d-NOEC (Crangon septemspinosa) = 32 mg/L (read-across ; CAS No. 1305-62-0)

Algae Not available

B. Persistence and degradability

Persistence Not available

Degradability Not available

C. Bioaccumulative potential

Bioaccumulation Not available

Biodegradation Not available

D. Mobility in soil Not available

E. Other hazardous effect Not available

13. Disposal considerations

A. Disposal method

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

B. Disposal precaution

- Consider the required attentions in accordance with waste treatment management regulation.

14. Transport information

A. UN Number Not applicable

B. UN Proper shipping name Not applicable

C. Transport Hazard class Not applicable

D. Packing group Not applicable

E. Marine pollutant Not applicable

F. Special precautions

in case of fire Not applicable

in case of leakage Not applicable

15. Regulatory information

A. Occupational Safety and Health Regulation

Beryllium : Occupational exposure limits listed
Authorization subject listed
Work environment monitoring listed (6 months)
Health examination agent (12 months)

Platinum : Administration subject listed
Work environment monitoring listed (6 months)
Occupational exposure limits listed

B. Toxic Chemical Control Act

Gold : Existing Chemical Substance (KE-18083)
Beryllium : Existing Chemical Substance KE-02829
Calcium : Existing Chemical Substance (KE-04462)
Palladium : Existing Chemical Substance (KE-27744)
Lanthanum : Existing Chemical Substance (KE-21820)
Platinum : Existing Chemical Substance (KE-28808)

C. Dangerous Material Safety Management Regulation

Calcium : Dangerous Material Safety Management Regulation 50 kg

D. Wastes Control Act Not regulated

E. Other regulation (internal and external)

Internal information

Persistant Organic Pollutants Acts Not regulated

External information

EU classification(classification)

Gold: Classification Not classified
Beryllium : Classification Carc. Cat.2; R49, T+;R26, T;R25-48/23, Xi;R36/37/38, R43
Calcium : Classification F; R15
Palladium: Classification Not classified
Lanthanum : Classification Not classified
Platinum : Classification Not classified

EU classification(risk phrases)

Gold: Hazard statements Not applicable
Beryllium : Hazard statements R49, R25, R26, R36/37/38, R43, R48/23
Calcium : Hazard statements R15
Palladium: Hazard statements Not applicable

Lanthanum : Hazard statements Not applicable
Platinum: Hazard statements Not applicable

EU classification(safety phrases)

Gold: Hazard statements Not applicable
Beryllium : Precautionary statements S53, S54
Palladium: Hazard statements Not applicable
Calcium : Precautionary statements S(2), S8, S24/25, S43
Lanthanum : Precautionary statements Not applicable
Platinum: Hazard statements Not applicable

EU SVHC list Not regulated
EU Authorisation List Not regulated
EU Restriction list Not regulated
U.S.A management information (OSHA Regulation) Not regulated
U.S.A management information (CERCLA Regulation) Not regulated
U.S.A management information (EPCRA 302 Regulation) Not regulated
U.S.A management information (EPCRA 304 Regulation) Not regulated
U.S.A management information (EPCRA 313 Regulation) Not regulated
Substance of Roterdame Protocol Not regulated
Substance of Stockholme Protocol Not regulated
Substance of Montreal Protocol Not regulated

Foreign Inventory Status

Gold

U.S.A management information Section 8(b) Inventory (TSCA): Present
China management information Inventory of Existing Chemical Substances (IECSC): Present 21085
Canada management information Domestic Substances List (DSL): Present

Australia management information Inventory of Chemical Substances (AICS): Present
New Zealand management information Inventory of Chemicals (NZIoC): May be used as a component in a product covered by a group standard but it is not approved for use as a chemical in its own right
Philippines management information Inventory of Chemicals and Chemical Substances (PICCS): Present

Beryllium

U.S.A management information Section 8(b) Inventory (TSCA): Present
China management information Inventory of Existing Chemical Substances (IECSC): Present 03971
Canada management information Domestic Substances List (DSL): Present
Australia management information Inventory of Chemical Substances (AICS): Present
New Zealand management information Inventory of Chemicals (NZIoC): May be used as a component in a product covered by a group standard but it is not approved for use as a chemical in its own right
Philippines management information Inventory of Chemicals and Chemical Substances (PICCS): Present
Japan management information Existing and New Chemical Substances (ENCS):

Calcium

U.S.A management information Section 8(b) Inventory (TSCA): Present
China management information Inventory of Existing Chemical Substances (IECSC): Present 13425
Canada management information Domestic Substances List (DSL): Present
Australia management information Inventory of Chemical Substances (AICS): Present
New Zealand management information Inventory of Chemicals (NZIoC): HSNO Approval: HSR001052
Philippines management information Inventory of Chemicals and Chemical Substances (PICCS): Present

Palladium

U.S.A management information Section 8(b) Inventory (TSCA): Present
China management information Inventory of Existing Chemical Substances (IECSC): Present 01362
Canada management information Domestic Substances List (DSL): Present
Australia management information Inventory of Chemical Substances (AICS): Present
New Zealand management information Inventory of Chemicals (NZIoC): May be used as a single component chemical under an appropriate group standard.
Philippines management information Inventory of Chemicals and Chemical Substances (PICCS): Present

Lanthanum

U.S.A management information Section 8(b) Inventory (TSCA): Present
Canada management information Domestic Substances List (DSL): Present
Australia management information Inventory of Chemical Substances (AICS): Present
New Zealand management information Inventory of Chemicals (NZIoC): May be used as a component in a product covered by a group standard but it is not approved for use as a chemical in its own right
Philippines management information Inventory of Chemicals and Chemical Substances (PICCS): Present

Platinum

U.S.A management information Section 8(b) Inventory (TSCA): Present
China management information Inventory of Existing Chemical Substances (IECSC): Present 04796
Canada management information Domestic Substances List (DSL): Present
Australia management information Inventory of Chemical Substances (AICS): Present
New Zealand management information Inventory of Chemicals (NZIoC): May be used as a component in a product covered by a group standard but it is not approved for use as a chemical in its own right
Philippines management information Inventory of Chemicals and Chemical Substances (PICCS): Present

16. Other information

A. Information source and references

U.S. National library of Medicine(NLM) Hazardous Substances Data Bank(HSDB); http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
American Conference of Governmental Industrial Hygienists TLVs and BEIs.
EU CLP; http://esis.jrc.ec.europa.eu/index.php?PGM=cla
IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; http://monographs.iarc.fr
Korea Occupational Health & Safety Agency; http://www.kosha.net
NIOSH Pocket Guide; http://www.cdc.gov/niosh/npg/npgdcas.html
National Chemicals Information System; http://ncis.nier.go.kr/ncis/
National Emergency Management Agency-Korea dangerous material inventory management system; http://www.nema.go.kr/hazmat/main/main.jsp
National Toxicology Program; http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm
REACH information on registered substances; http://apps.echa.europa.eu/registered/registered-sub.aspx
The Chemical Database -The Department of Chemistry at the University of Akron; http://ull.chemistry.uakron.edu/erd/
TOMES-LOLI®; http://www.rightanswerknowledge.com/loginRA.asp
UN Recommendations on the transport of dangerous goods 17th
Waste Control Act enforcement regulation attached [1]

B. Issuing date : 2009.08.02

C. Revision number and date

revision number : Rev. 6

date of the latest revision : 2016.4.26

D. Others

•Revised Material Safety Data Sheet based on the amendments made on the Ministry of Employment and Labor Public Notice on Standard for Classification Labeling of Chemical Substance and Material Safety Data Sheet.

•This MSDS is authored in pursuant to the Article 41 of the Occupational Safety and Health Act.

•The content is based on the latest information and knowledge that we currently possess.

•This MSDS was authored to aid buyer, processor or any other third person who handles the chemical of subject in the MSDS; additionally, it does not warrant suitability of the chemical for special purposes or the commercial use of statements that approves the use of it in combination with other chemicals as well as technical or legal liabilities.

< Revision History >

Rev. no.	Date.	Description	Preparer
0	02. Aug, 2009	Initial establishment	NY Seo
1	22. Sep, 2009	Review / No change	NY Seo
2	11. May, 2012	Review / No change	NY Seo
3	28. Aug, 2013	Review / No change	NY Seo
4	14. Oct, 2013	Add Gold Wire (2N)-UP Type & review the overall aspects in accordance with the change of the Occupational Safety and Health Act.	NY Seo
5	09. May, 2014	Review / No change	NY Seo
6	26. Apr, 2016	Review / No change	NY Seo