

Material Safety Data Sheet

Electrochemical Toxic Gas Sensor

SECTION I - MANUFACTURER AND CONTACT INFORMATION

Supplier: RAE Systems Inc.
Address: 3775 North First Street
San Jose, CA 95134 USA

Telephone Number: 408-952-8200
FAX Number: 408-952-8480
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SECTION II - HAZARDOUS COMPONENTS

| <u>Component</u> | <u>Formula</u> | <u>CAS No.</u> |
|--|--------------------------------|----------------|
| a. Sulfuric Acid, 5 M (38%) in water or ortho-Phosphoric Acid, 5.7 M in water | H ₂ SO ₄ | 7664-93-9 |
| | H ₃ PO ₄ | 7664-38-2 |
| b. Platinum black | Pt | 7440-06-4 |
| c. Ruthenium black | Ru | 7440-18-8 |
| d. Gold powder | Au | 7440-57-5 |
| e. Silver powder | Ag | 7440-22-4 |
| f. Graphite (Carbon) | C | 7782-42-5 |

Note: Each sensor contains one acid (component a) and a mixture of components b - f. Not all of the above components are necessarily contained in each sensor. The SO₂ and PH₃ sensors use phosphoric acid electrolytes, while all others (Cl₂, CO, HCN, NO, NO₂, & H₂S) use sulfuric acid.

SECTION III - PHYSICAL & CHEMICAL PROPERTIES

| <u>Component:</u> | <u>H₂SO₄</u> | <u>H₃PO₄</u> | <u>Pt</u> | <u>Ru</u> | <u>Au</u> | <u>Ag</u> | <u>C</u> |
|-----------------------|------------------------------------|------------------------------------|--------------|-------------|------------------------|-------------------|-------------------|
| <u>Description:</u> | Colorless aqueous solution | Colorless aqueous solution | Black powder | Gray powder | Yellow to brown powder | Gray-white powder | Soft black scales |
| <u>Melting Point:</u> | n/a | n/a | 1772 °C | 2334 °C | 1064 °C | 962 °C | n/a |
| <u>Boiling Point:</u> | 330 °C (100%) | 158 °C (100%) | 3827 °C | 4150 °C | 2808 °C | 2212 °C | n/a |
| <u>Vapor Press.:</u> | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| <u>Vapor Density:</u> | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| <u>Evapor. Rate:</u> | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| <u>Density:</u> | 1.29 g/cc | ~1.3 g/cc | 21.5 g/cc | 12.5 g/cc | 19.3 g/cc | 10.5 g/cc | 2.25 g/cc |
| <u>Water solubil:</u> | miscible | miscible | n/a | insoluble | insoluble | n/a | insoluble |

SECTION IV - FIRE AND EXPLOSION HAZARDS

All components are non-combustible except graphite, a minor component. The acid electrolytes may evolve heat on dilution of large quantities. When dispersed, the metal powders may promote the oxidation and ignition of flammable liquids and vapors. Some components (esp. sulfuric acid) evolve toxic fumes in a fire. Applying an excessive potential to the cell may cause it to heat and rupture.

FIRE FIGHTING MEASURES - Water spray, foam, dry powder, sand or carbon dioxide.

SECTION V - REACTIVITY

STABILITY: The sulfuric and phosphoric acids are very corrosive. All components are stable under ambient conditions. Very high and low humidity will dilute or dry out the electrolyte, respectively.

CONDITIONS TO AVOID: Avoid heat sources and do not apply a potential to the cell.

INCOMPATIBILITIES: Bases, oxidizers, halides, organic reductants, powdered non-noble metals.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION VI - HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY: INHALATION? No. SKIN? Yes. INGESTION? Yes.

HEALTH HAZARDS (Acute & Chronic):

Sulfuric and phosphoric acids: Strongly corrosive to skin, eyes, and respiratory tract. Exposure symptoms include burning sensation, coughing, wheezing, shortness of breath, nausea, and vomiting.

Platinum, Gold, Silver & Ruthenium: These metals are practically non-toxic. Irritating to eyes and respiratory system if inhaled as dust. Gold salts may leave persistent purple stains on the skin and, in rare instances, cause allergic reactions. Chronic absorption of silver may cause "Argyria," a blue/gray discoloration of various tissues, including skin, respiratory tract, eyes, and nails.

Carbon: May be harmful if ingested in quantity. Irritating to eyes and respiratory system if inhaled as dust. May cause allergic reactions.

| <u>Component</u> | <u>H₂SO₄</u> | <u>H₃PO₄</u> | <u>Pt</u> | <u>Ru</u> | <u>Au</u> | <u>Ag</u> | <u>C</u> |
|-------------------|------------------------------------|------------------------------------|-------------------------------------|-------------|-------------------------------|----------------------------------|---------------------|
| U.S. 8-hr TWA | 1 mg/m ³ | 1 mg/m ³ | 1 mg/m ³ | Not establ. | Not establ. | 0.1 mg/m ³ | 2 mg/m ³ |
| Acute Toxicity | LDLO 135 mg/kg UNR -man | See effects noted above | LDLO 5250 mg/kg implant - rat | No data | LDLO 58 mg/kg ivn - rat | LDLO 49 mg/kg ivn - rabbit | No data |
| Mutagen/Teratogen | No data | no evidence | No data | No | No data | No | No evid. |
| Carcinogen | Yes | no evidence | No data | No | No data | No | No evid. |

FIRST AID PROCEDURES

Skin & Eyes: Wash with copious amounts of water, and in severe cases seek medical attention.

Ingestion: Give plenty of water to drink. Seek medical attention.

Inhalation: Remove from exposure, rest and keep warm. Seek medical attention.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

During normal operation, users are not exposed to the hazardous components. The potential for hazardous exposure exists after physical damage to the cell, as may be caused by crushing, piercing, or electrical misuse. In such cases the primary hazard results from the corrosive nature of the sulfuric or phosphoric acid electrolyte. Secondary toxic or carcinogenic effects may result from exposure to the inorganic components or the electrolyte, mostly if ingested. If dried and broken, dust may be inhaled.

LEAK & DISPOSAL PROCEDURES

Contain any large leaks using a plastic vessel. Cover with lime, sand, or soda ash. Very small leaks may be diluted with plenty of water or water mixture. Neutralize washings with calcium carbonate or dilute caustic and dispose of them and/or sensor according to local regulations for non-hazardous waste.

SECTION VIII - CONTROL MEASURES

Avoid skin contact through use of personal protective equipment. Avoid Inhalation or ingestion.

| <u>Respirator</u> | <u>Ventilation</u> | <u>Gloves</u> | <u>Eye Protection</u> | <u>Other Measures</u> |
|-------------------|--------------------|-------------------|------------------------|------------------------|
| Dust respirator | Hood | Rubber or plastic | Goggles or face shield | Plastic apron & sleeve |

Store in a sealed plastic container at 0 °C (except Cl₂ sensors) when not in use to preserve humidity and contain any leaks. Store Cl₂ sensors at room temperature.

SECTION IX - FURTHER INFORMATION

For more details contact the manufacturer or supplier for an MSDS of the individual components.