SAFETY DATA SHEET

SECTION 1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Identifier  Faraday Rotator GMF
Product name  Rare-earth Iron Garnet single crystals (RIG)

Manufacturer/Supplier  GRANOPT Co., Ltd.
Address  4-4 Ougibuchi, Aza, Ougida, Noshiro-shi, Akita
          016-0122, Japan
Division  Quality assurance group
Phone  +81-185-70-1800
Fax  +81-185-70-1803

SECTION 2 – HAZARDS IDENTIFICATION

GHS Classification

Health hazards  Germ cell mutagenicity / Category 2
               Carcinogenicity / Category 2
               Reproductive toxicity / Category 1A
               Specific target organ / Systemic toxicity / Category
               Serious eye damage / Eye irritation / Category 1
               Specific target organs / systemic toxicity
               Respiratory system / Category 1 Repeated
               Specific target organs / systemic toxicity Category
               3 (airway severe) Single exposure
               Specific target organs / systemic toxicity Category
               1 (respiratory system) Repeated exposure

Environmental hazard  Aquatic environment Chronic hazards / Category 4

GHS label
Symbols

Signal words  Danger
Hazard statements  H315 Causes skin irritation
                H318 Causes serious eye damage
                H335 May cause respiratory irritation
                H370 Causes damage to organs (Nervous system, Kidney, osteoarticular)
                H372 Causes damage to organs (respiratory system, Nervous system, Kidney, osteoarticular) through prolonged or repeated exposure

Precautionary statements
【Prevention】  Keep container tightly closed. (P233)
               Wash hands thoroughly after handling. (P264)
               Do not eat, drink or smoke when using this product. (P270)
### SECTION 3 – COMPOSITION/INFORMATION ON INGREDIENTS

#### Classification of the substance or mixture

<table>
<thead>
<tr>
<th>Chemical name or generic name</th>
<th>Concentration or Concentration range</th>
<th>Chemical property</th>
<th>Reference number in gazetted list in Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diiron trioxide (3)</td>
<td>33%</td>
<td>Fe₂O₃</td>
<td>Existing (1)-357,(5)-5188</td>
</tr>
<tr>
<td>Bismuth oxide</td>
<td>60.6%</td>
<td>Bi₂O₃</td>
<td>Existing (1)-98</td>
</tr>
<tr>
<td>Rare-earth oxide</td>
<td></td>
<td>R₂O₃</td>
<td>Proprietary</td>
</tr>
<tr>
<td>Gallium oxide</td>
<td>6.3%</td>
<td>Ga₂O₃</td>
<td>Existing (1)-695</td>
</tr>
<tr>
<td>Lead monoxide (2)</td>
<td>0.1%</td>
<td>PbO</td>
<td>Existing (1)-527</td>
</tr>
</tbody>
</table>

#### Impurity and stabilization additive of contributing to a classification

- No information available.

#### The Industrial Safety and Health Law

- Dangerous and Toxic Substances Subject to Notify Their Names, etc. (2 of law Article 57, 2 separate tables ninth of enforcement order Article 18)

- Lead and the inorganic compound (Ordinance No.: 411)(0.1%)
- Diiron trioxide (Ordinance No.: 192) (33%)

#### Information as the mixture

- This product is classified as a mixture, but it is equivalent to a single compound which consists of compounds listed in the component table. The

### Response

- Use only outdoors or in a well-ventilated area. (P271)
- Wear protective gloves. (P280)
- Wear eye protection/face protection. (P280)
- IF ON SKIN: Gently wash with plenty of soap and water. (P302+P352)
- IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing. (P304+P340)
- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. (P305+P351+P338)
- Immediately call a POISON CENTER or doctor/physician. (P310)
- Call a POISON CENTER or doctor/physician if you feel unwell. (P312)
- If skin irritation occurs: Get medical advice/attention. (P332+P313)
- Take off contaminated clothing and wash before re-use. (P362)

### Storage

- Store at normal temperatures and normal humidity.

### Disposal

- Dispose of contents and container in accordance with all local, regional, national and international regulations. (P501)
SECTION 4—FIRST AID MEASURES

Inhalation

Remove to fresh air and keep at rest in a position comfortable for breathing.

Call a POISON CENTER or doctor/physician.

Skin contact

Wash contaminated clothing before reuse.

Call a POISON CENTER or doctor/physician if you feel unwell.

Wash with soap and water.

Remove/Take off immediately all contaminated clothing.

Eyes contact

Rinse cautiously with water for several minutes.

Remove contact lenses, if present and easy to do. Continue rinsing.

Call a POISON CENTER or doctor/physician.

Rinse mouth.

Call a POISON CENTER or doctor/physician if you feel unwell.

Call a POISON CENTER or doctor/physician.

SECTION 5—FIRE FIGHTING MEASURES

Suitable extinguishing media

No information available.

Special protective equipment and precautions for fire-fighters

Wear proper protection Use Self-Contained Breathing Apparatus (SCBA), chemical protective clothing.

SECTION 6—ACCIDENTAL RELEASE MEASURES

Personal precautions:

(protective equipment and emergency measures)

Collection and neutralization

Handling person should wear suitable protective equipment as indicated in section 8. Avoid contact with eye or skin. Avoid breathing gas.

Vacuum up or sweep up spillage and collect in suitable container for disposal.

Absorb the leakage with inert material (e.g. dry sand, soil, etc.,) and collect in a container for disposal of chemical product.

Scoop up or use appropriate absorber to remove from the water surface. Do not use dispersant. Substance is to solidify and gather up. after eliminating, clean completely contaminated area with water.

Methods and materials for containment and cleaning up

SECTION 7—HANDLING AND STORAGE

Handling

Technical measures

Take equipment measures and wear suitable protective equipment as indicated in section 8 (EXPOSURE CONTROL/PERSONAL PROTECTION).

Total or local exhaust ventilation

Use total or local exhaust ventilation as indicated in section 8 (EXPOSURE CONTROL/PERSONAL PROTECTION).

Precautions for safe handling

Avoid contact with eyes and skin.

Do not eat, drink or smoke when using this product.
Prevention of Contact

Storage

Incompatible materials

Storage conditions

Safe packaging materials

Refer section 10–STABILITY AND REACTIVITY.

Refer section 10–STABILITY AND REACTIVITY.

No information available.

SECTION 8–EXPOSURE CONTROL/PERSONAL PROTECTION

Administrative level, Occupational exposure limits

<table>
<thead>
<tr>
<th></th>
<th>Administrative level</th>
<th>Japan Society for Occupational Health</th>
<th>ACGIH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diiron trioxide</td>
<td>Not established.</td>
<td>【Dust occupational exposure limits】(Class 2 dust) Respirable dust 1mg/m3 Total dust 4mg/m3</td>
<td>TWA 5mg/m3 (R)</td>
</tr>
<tr>
<td>Bismuth trioxide</td>
<td>Not established.</td>
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<tr>
<td>Gallium oxide</td>
<td>3.0mg/m3</td>
<td>【Dust occupational exposure limits】(Class 3 dust) Respirable dust 2mg/m3 Total dust 8mg/m3</td>
<td>TLV–TWA 3mg/m3(Respirable Dust) TLV–TWA 10mg/m3(Suction Dust)</td>
</tr>
<tr>
<td>Litharge</td>
<td>0.05mg/m3(As Pb)</td>
<td>0.1mg/m3(As Pb. excluding alkylled lead compound)</td>
<td>TWA 0.05mg/m3 (As Pb)</td>
</tr>
</tbody>
</table>

Equipment measures

If dust or fume is produced in thermal process, install ventilating equipment to keep the atmospheric concentration of the air contaminant below the administrative level or allowable exposure limit.

Personal protection equipments

Respiratory protection

Wear suitable dust mask.

Hand protection

Wear suitable protective gloves.

Eye protection

Wear suitable eye protection.

Specific Hygiene Measures

Wash hands thoroughly after handling.

SECTION 9–PHYSICAL AND CHEMICAL PROPERTIES

As product

Physical state

Chip-like solid (Ambient temperature)

Melting point/freezing point

cia. 1,200℃

Relative weight (Density)

6.6(Ambient temperature)

Solubility

Soluble in strong acid and strong alkaline

Decomposition temperature

No data available
**SECTION 10—STABILITY AND REACTIVITY**

**Stability**

- Possibility of hazardous reaction: No data available
- Condition to avoid: No data available
- Hazardous decomposition products: No data available

**SECTION 11—TOXICOLOGICAL INFORMATION**

**As product**

- Acute toxicity (oral): No data available
- Acute toxicity (dermal): No data available
- Acute toxicity (inhalation: gas): Classified as “solid” according to GHS definition.
- Acute toxicity (inhalation: vapour): No data available
- Acute toxicity (inhalation: dust): No data available

Since this product is solid form and most vapor pressures can be disregarded, it is thought that the inhalation study was done with the dust. Since there was no study in which LC50 value was acquired, data is insufficient and it cannot be classified.
Acute toxicity (inhalation: mist)

Since this product is solid form and most vapor pressures can be disregarded, it is thought that the inhalation study was done with the dust. Since there was no study in which LC50 value was acquired, data is insufficient and it cannot be classified.

Skin corrosion / irritation

Based on the description of redness and moderate irritation on humans (ICSC (J) (2004), IUCLID (2000)), it was classified as Category 2.

Serious eye damage / eye irritation

Based on the description with corrosive in humans (IUCLID (2000)), it was set as Category 1.

Respiratory/skin sensitizer

Respiratory: No data available, skin sensitizer: Classification not possible due to lack of data. There were no in vivo test results and there was no strong positive finding of multiple indices for the in vitro test. Therefore we presupposed that we could not categorize it according to the technical guideline.

Germ cell mutagenicity

No data available

Carcinogenicity

Based on being classified into A4 according to ACGIH, it carried out the outside of Category.

Toxic to reproduction

No data available

Specific target organs/systemic toxicity following single exposure

The coughing was seen in humans and it is classified into Category 3 (respiratory irritation) based on the publication that there is also closeness (ICSC (J), (2004), IUCLID (2000)).

Specific target organs/systemic toxicity following repeated exposure

There is the statement that although abnormalities are found on a chest x-rays test in humans, it is clinically satisfactory (ACGIH (2001)), and there is also a statement if it accumulates in a lungs, it will become siderosis, but it is benign and does not progress to fibrosis (ACGIH (2001)). Moreover, there is a statement that metal fevers may be occurred by exposure (IUCLID (2000)). Since the lung effects was seen inspite of being benign, and metal fevers might be affected, it was classified into Category 1 (respiratory systems).

Aspiration hazard

No data available

As Bismuth trioxide

Acute toxicity (oral)

Classification is not possible due to lack of data. A data of LD 50 = 4 mg /kg (RTECS (2007)) is available. “See other hazard data of bismuth compound as well.”

Acute toxicity (dermal)

No data available

Acute toxicity (inhalation: gas)

No data available

Acute toxicity (inhalation: vapour)

No data available

Acute toxicity (inhalation: dust)

No data available

Acute toxicity (inhalation: mist)

No data available

Skin corrosion / irritation

No data available

Serious eye damage / eye irritation

No data available
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<thead>
<tr>
<th>Category</th>
<th>Specific Target</th>
<th>Acute toxicity (oral)</th>
<th>Acute toxicity (dermal)</th>
<th>Acute toxicity (inhalation: gas)</th>
<th>Acute toxicity (inhalation: vapour)</th>
<th>Acute toxicity (inhalation: dust)</th>
<th>Acute toxicity (inhalation: mist)</th>
<th>Skin corrosion / irritation</th>
<th>Serious eye damage / eye irritation</th>
<th>Respiratory/skin sensitization</th>
<th>Germ cell mutagenicity</th>
<th>Carcinogenicity</th>
<th>Toxic to reproduction</th>
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<td>Respiratory/skin sensitization</td>
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<td>Acute toxicity (inhalation: gas)</td>
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<td>Serious eye damage / eye irritation</td>
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<td>Carcinogenicity</td>
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<td>Toxic to reproduction</td>
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</table>

It is described that encephalopathy, nephropathy, osteoarthritis, gingivitis, stomatitis, colitis are caused by bismuth and bismuth compounds as general toxic effect to human (skin sensitizer). In addition, there is a description that clinical symptoms in acute poisoning are similar to those caused by mercury and lead which include neurologic abnormality accompanied by encephalopathy, renal dysfunction accompanied by nephritic syndrome (PATTY (5th, 2001)). Based on this, the product is classified into Category 1 (nervous system, kidney, articular).

It is described that encephalopathy, nephropathy, osteoarthritis, gingivitis, stomatitis, etc., are caused by bismuth and bismuth compounds as general toxic effect to human and that inorganic bismuth causes neurotoxicity (PATTY (5th, 2001)). Based on this, the product is classified into Category 1 (nervous system, articular, kidney). Also, there is a report that chronic toxicity such as anorexia nervosa, rheumatalgia, diarrhea, fever, halitosis, gingivitis, dermatitis were noted in human (HSDB (2002)).
Specific target organs/systemic toxicity following single exposure
Specific target organs/systemic toxicity following repeated exposure

As Litharge
<table>
<thead>
<tr>
<th>Acute toxicity (oral)</th>
<th>No data available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute toxicity (dermal)</td>
<td>No data available</td>
</tr>
<tr>
<td>Acute toxicity (inhalation: gas)</td>
<td>Due to the fact that the substance is “solid” according to the GHS definition and inhalation of its gas is not expected.</td>
</tr>
<tr>
<td>Acute toxicity (inhalation: vapour)</td>
<td>No data available</td>
</tr>
<tr>
<td>Acute toxicity (inhalation: dust)</td>
<td>No data available</td>
</tr>
<tr>
<td>Acute toxicity (inhalation: mist)</td>
<td>No data available</td>
</tr>
<tr>
<td>Skin corrosion / irritation</td>
<td>Based on the description in the report on rabbit skin irritation tests (CERI Hazard Data 2001–9 (2002)) “mild irritation”. It was classified as Category 3. Refer to other data on lead and its compounds (primarily inorganic lead)</td>
</tr>
<tr>
<td>Serious eye damage / eye irritation</td>
<td>No data available Refer to other data on lead and its compounds (primarily inorganic lead)</td>
</tr>
<tr>
<td>Respiratory/skin sensitizer</td>
<td>Respiratory sensitizer: No data available Refer to other data on lead and its compounds (primarily inorganic lead) Skin sensitizer: No data available Refer to other data on lead and its compounds (primarily inorganic lead)</td>
</tr>
<tr>
<td>Germ cell mutagenicity</td>
<td>Based on many reports on the occupational exposure to lead compounds and the results of epidemiological studies: lead compounds induce chromosome aberration and micronucleated cells in human peripheral blood cells (SCE formation is also observed). Although no data are available on the evaluation of lead oxides per se, the results of epidemiological studies should be taken into account in view of their human germ cell mutagenicity. However, classification may not be possible, if based on the description in IARC 23 (1980): data on multi-generation mutagenicity tests, germ/somatic cell mutagenicity tests in vivo and germ/somatic cell genotoxicity tests in vivo are not available, and in vitro mutagenicity tests do not show strong positive results (in several indexes). It was classified as Category 2.</td>
</tr>
</tbody>
</table>
Carcinogenicity

Category 2, Based on the classification by NTP (2005) (R: Lead and Lead Compounds), IARC (1987) (Group 2B: Lead and Inorganic Lead Compounds) and the Japan Society of Occupational Health (2B: Lead Compounds (Inorganic)). It was classified as Category 2.

Toxic to reproduction

Based on the description in IARC 23 (1980): The results of epidemiological studies conducted at lead smelters suggest a significant increase in spontaneous abortion rates. It was classified as Category 1A. (Workers in lead smelters may be exposed to lead fume, which is probably lead monoxide.)

Specific target organs/systemic toxicity

No data available

Aspiration hazard

No data available

SECTION 12- ECOLOGICAL INFORMATION

As product

Environmental Hazards

No information available.

Ecotoxicity data

No information available.

As Diiron trioxide

Environmental Hazards

Hazardous to the aquatic environment (acute): Classification not possible due to lack of data
Hazardous to the aquatic environment (chronic): Classification not possible due to lack of data

As Bismuth trioxide

Environmental Hazards

Hazardous to the aquatic environment (acute): (unclassified)
Hazardous to the aquatic environment (chronic): (unclassified)

As Gallium oxide

Environmental Hazards

No data available

Ecotoxicity data

No data available

As Litharge

Environmental Hazards

Hazardous to the aquatic environment (acute): Classification not possible due to lack of data
Hazardous to the aquatic environment (chronic): Since although acute toxicity is not reported within the aqueous solubility concentrations, it was a metallic compound, and the underwater action was unknown, it was classified into Category 4.
SECTION 13—DISPOSAL CONSIDERATIONS

Residual waste

Lower hazard level as much as possible before disposal by detoxification, stabilization or neutralization processing.

Waste disposal should be in accordance with existing federal, state and local environmental control laws.

Entrust disposal to officially recognized expert traders or disposal dealers with the permission of the prefectural governor, or entrust to local public entities if they are dealing disposal.

Entrust disposal by notifying dangerous and hazardous information thoroughly to waste treatment company.

Waste material categorized as “Special designated hazardous industrial waste” of “Special Control Industrial Waste” should be disposed in accordance with applicable and related regulation.

Avoid direct release to the rivers, etc., landfill or disposal of the effluent and washing water containing this product.

Recycle used containers by cleaning or dispose appropriately in accordance with official regulation.

Dispose of empty container after eliminating contents completely.

Including contaminated containers and packaging

SECTION 14—TRANSPORT INFORMATION

<table>
<thead>
<tr>
<th>International regulations</th>
<th>Marine regulation</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN number</td>
<td>Marine Pollutant</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Aviation regulation</td>
<td>information</td>
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</table>

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<th>Domestic regulation information</th>
<th>UN number</th>
<th>Not applicable</th>
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<tr>
<td>Land regulation information</td>
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<td>Marine regulation information</td>
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<td>Marine Pollutant</td>
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</tr>
<tr>
<td>Aviation regulation information</td>
<td></td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

SECTION 15—REGULATORY INFORMATION

The Industrial Safety and Health Law

Dangerous and Toxic Substances Subject to Notify Their Names, etc. (law Article 57 1, enforcement order Article 18)
Law concerning Pollutant Release and Transfer Register
Poisonous and Deleterious Substances Control Act
Directive RoHS
Restriction of the use of certain hazardous substances in electrical and electronic equipment.

Directive RoHS is not applicable for this product, but is based on directive RoHS.

Include compound (PbO) corresponding to Class I Designated Chemical Substances.

SECTION 16–OTHER INFORMATION
Risk assessment

<table>
<thead>
<tr>
<th></th>
<th>Health</th>
<th>Fire</th>
<th>Reactivity</th>
<th>Personal Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard level</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3~4</td>
</tr>
<tr>
<td>Description</td>
<td>0 Low hazard</td>
<td>1 Small</td>
<td>2 Normally</td>
<td>3~4 High hazard</td>
</tr>
</tbody>
</table>

Hazard assessment procedure: HMIS
Reason for revision: New SDS

The information in this SDS was obtained from current and reputable sources, data and information. However, composition content, physical and chemical property, danger and hazard information data are it may be updated based on the new scientific finding and test data etc., As cautions described are for normal usage, and it is assumed any chemical product has unknown hazard, extreme caution is required for handling. It is the user’s responsibility to determine safe conditions for use of this product. For special handling, please use it in the light of suitable safety measures for application and usage.