



SAFETY DATA SHEET

Trade name: Graphene Coating

Revised September, 2021 GP 2.0.c

1. Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier:

Product Name Graphene coating, Graphene ink, Graphene painting
Product Code I-HS41

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses of the product To increase heat dissipation performance of thermal management devices

1.3 Details of the supplier of the safety data sheet

Manufacturer/ Supplier Enerage Inc.
Address No.5, Ligong 3rd Rd., Wujie Township, Yilan County 26841, Taiwan, R.O.C.
Phone number 886-3-990-2100
Fax 886-3-990-2500

1.4 Emergency phone number 886-3-990-2100

2. Hazards identification

GHS classification and label elements of the product

2.1 Classification of the substance or mixture

Physical and Chemical hazards	Flammable liquids	Category 2
Health hazards	Skin Corrosion/Irritation	Category 3
	Serious Eye Damage/Eye Irritation	Category 2A
	Specific target organ toxicity, single exposure Acute Toxicity, oral	Category 3 (Narcotic effects) Category 4

2.2 Label elements



Signal word Danger

Hazard statements
H300 Fatal if swallowed
H301 Toxic if swallowed
H315 Causes skin irritation
H319 Causes serious eye irritation.
H332 Harmful if inhaled
H335 May cause respiratory irritation
H336 May cause drowsiness or dizziness.

Precautionary statements

Prevention P102 Keep out of reach of children



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- P103 Read label before use.
- P201 Obtain special instructions before use
- P202 Do not handle until all safety precautions have been read and understood
- P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking
- P211 Do not spray on an open flame or other ignition source.
- P233 Keep container tightly closed.
- P243 Take precautionary measures against static discharge.
- P244 Keep valves and fittings free from oil and grease.
- P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
- P270 Do not eat, drink or smoke when using this product
- P271 Use only outdoors or in a well-ventilated area.
- P272 Contaminated work clothing should not be allowed out of the workplace.
- P273 Avoid release to the environment.
- P280 Wear protective gloves/protective clothing/eye protection/face protection
- P281 Use personal protective equipment as required.
- P282 Wear cold insulating gloves/face shield/eye protection.
- P284 Wear respiratory protection
- P285 In case of inadequate ventilation wear respiratory protection
- P235+410 Protect from sunlight

Response

- | | |
|---------------------------------|---|
| P301 IF SWALLOWED | P330 Rinse mouth. |
| | P331 Do NOT induce vomiting. |
| | P313 Get medical advice/attention |
| P303 IF ON SKIN (or hair) | P351 Rinse cautiously with water for several minutes. |
| | P352 Wash with plenty of soap and water. |
| | P353 Rinse skin with water/shower. |
| P304 IF INHALED | P314 Call a POISON CENTER/doctor if you feel unwell. |
| | P340 Remove victim to fresh air and keep at rest in a position comfortable for breathing. |
| P305 IF IN EYES | P338 Remove contact lenses, if present and easy to do. Continue rinsing. |
| | P351 Rinse cautiously with water for several minutes. |
| P337 If eye irritation persists | P313 Get medical advice/attention. |
| P370 In case of fire | P374 Fight fire with normal precautions from a reasonable distance. |
| | P376 Stop leak if safe to do so. |
| | P378 Use water, carbon dioxide, dry chemical powder or alcohol resistant foam for |



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	extinction.
Storage	P402 Store in a dry place. P403 Store in a well-ventilated place. P404 Store in a closed container. P405 Store locked up.
Disposal	P501 Dispose of contents/ container to an approved waste disposal plant.

3. Composition/information on ingredients

<u>Chemical name</u>	<u>CAS No.</u>	<u>Content (wt%)</u>
Co-solvent	123-86-4, 112-15-2, 78-59-1, 78-93-3, 1330-20-7	40~60 wt%
Resin	proprietary	50~70 wt%
Graphene	1034343-98-0	5~15 wt%

4. First-aid measures

4.1 Descriptions of first-aid measures

General measures	In the case of prolonged irritation or other adverse effects, contact a doctor.
IF ON SKIN (or hair)	Wash with soap and water. If skin irritation occurs, get medical advice/ attention. Contaminated clothing should be removed and washed thoroughly before re-use.
IF INHALED	Remove from exposure to fresh air and call a poison center/ doctor to get medical advice/ attention. If breathing is difficult, administer oxygen. If breathing has stopped, begin artificial respiration immediately, and seek medical attention.
IF IN EYES	Flush eyes with water for at least 15 minutes. If easy to do, remove contact lens. Get medical attention
IF SWALLOWED	Rinse mouth with water and consult a physician. Never give anything to an unconscious person.

4.2 Most important symptoms/ effects, acute and delayed

Symptoms	May cause irritation to skin, eyes and respiratory tract.
Hazards	No information about adverse effects due to exposure

4.3 Indication of immediate medical attention and special treatment needed.

Treatment	Symptoms may be delayed. Treat symptomatically.
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5. Fire-fighting measures

5.1 Extinguishing media



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Suitable extinguishing media	Water, carbon dioxide, dry chemical powder or alcohol resistant foam.
Unsuitable extinguishing media	No data available
5.2 Specific hazards arising from the substance or mixture	<p>In the event of combustion or thermal decomposition, this material may release carbon monoxide (CO) or carbon dioxide (CO₂).</p> <p>Flammable liquid and vapor.</p> <p>Can be ignited easily and burns vigorously.</p> <p>Vapors may cause a flash fire or ignite explosively.</p> <p>Vapors may travel considerable distance to a source of ignition and flash back.</p> <p>Prevent buildup of vapors or gases to explosive concentrations.</p>
5.3 Advice for firefighters	
Special protective equipment and precautions for fire-fighters	Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.
Specific fire-fighting measures	<p>Cool containers exposed to flames with water until well after the fire is out.</p> <p>In case of fire and/or explosion do not breathe fumes.</p> <p>Keep away from any heat source or electronic circuits.</p> <p>Water may be ineffective in fighting the fire.</p>
6. Accidental release measures	
6.1 Personnel precautions, protective equipment and emergency procedures	<p>Evacuate personnel to safe areas.</p> <p>Remove all sources of ignition if safe to do.</p> <p>Should wear suitable protective equipment to prevent inhalation or skin contact.</p> <p>Should beware of the risk of slippage due to the material's low coefficient of friction.</p> <p>Keep upwind.</p>
6.2 Environmental precautions	<p>Prevent further leakage or spillage if safe to do so.</p> <p>Do not contaminate water sources or sewer.</p> <p>Avoid discharge into drains, water courses or onto the ground</p>
6.3 Methods and materials for containment and cleaning up	<p>Collect spillage with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations.</p> <p>Do not discharge into storm or sanitary sewers or groundwater.</p>
7. Handling and storage	
7.1 Precautions for safe handling	
Preventive measures	<p>(Exposure Control for handling personnel)</p> <p>Do not breathe dust/fume/gas/mist/vapors/spray.</p> <p>Avoid breathing dust/fume/gas/mist/vapors/spray.</p> <p>(Protective measures against fire and explosion)</p>



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Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

Ground/bond container and receiving equipment.

Use explosion-proof electrical/ventilating/lighting equipment.

Use only non-sparking tools.

Take precautionary measures against static discharge.

Safety Measures/Incompatibility

Obtain special instructions before use.

Do not handle until all safety precautions have been read and understood.

Use only outdoors or in a well-ventilated area.

Wear protective gloves and face protection.

Use personal protective equipment as required.

Remove contaminated clothing and wash the skin thoroughly with soap and water after work.

7.2 Conditions for safe storage, including any incompatibilities

Recommendation for storage

Store in a well-ventilated place and keep cool.

Keep container tightly closed

Store locked up.

Graphene is electrically conductive. Avoid accumulations of graphene in places where these accumulations could cause shorting of electrical switches, circuits or components since any dust can form a potentially explosive mixture in air.

8. Exposure controls/personal protection

8.1 Engineering controls

Provide adequate workplace ventilation. If vapor/dusts are generated through handling, local exhaust ventilation should be employed.

Eye wash facilities and emergency shower must be available when handling this product.

Respiratory protection may be needed for non-routine or emergency situations.

8.2 Exposure controls

<u>Components</u>	<u>Type</u>	<u>Exposure limit(s)</u>	<u>Source</u>
Toluene	US IDLH	500 ppm	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	NIOSH REL (TWA)	375 mg/m ³	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	NIOSH REL (TWA)	100 ppm	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	NIOSH REL (STEL)	560 mg/m ³	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	NIOSH REL (STEL)	150 ppm	US. NIOSH: Pocket Guide to Chemical Hazards (2010)



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OSHA PEL (TWA)	200 ppm	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
OSHA PEL (Ceiling)	300 ppm	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)

8.3 Personal protective Equipment

General

Good general ventilation (typically 10 air changes per hour) should be used.

Ventilation rates should be matched to conditions.

If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits.

If exposure limits have not been established, maintain airborne levels to an acceptable level.

An eye wash and safety shower must be available in the immediate work area.

Respiratory protection

To minimize risk of over exposure to dust, vapor or fumes, it is recommended that a local exhaust system is placed above the equipment, and that the working area is properly ventilated.

If ventilation is inadequate, use certified respirator that will protect against dust/mist.

Eye/face protection

Wear suitable safety eyeglasses or chemical protective goggles or other face protection.

Skin and body protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place.

Hand protection

Handle with gloves. Gloves must be inspected prior to use.

Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product.

Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices.

Hygiene

Do not eat, drink or smoke when using the product.

Wash hands after handling.

Observe good industrial hygiene practices.

9. Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

Appearance	colloidal liquid
Color	Gray to black
Odor	No data available
Odor threshold	No data available
pH	No data available
Melting point	-47.4°C



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	Graphene: >3600°C
Initial boiling point	138.5 °C
Flash point	40°C
Auto-ignition temperature	Graphene: dispersed dust cloud: >600°C
Flammability (solid, gas)	Class IB Flammable Liquid
Flammable limit	2~11.5 %(V)
Evaporation rate	4.1 6 (butyl acetate=1)
Vapor density	1.2
Vapor pressure	No data available
Decomposition temperature	No data available
Density	0.9~1.1 g/cm ³ @20°C
Solubility in water	0.864 g/cm ³ @20°C
Solubility (other)	No data available
Partition coefficient (n-Octanol/water)	No data available

10. Stability and Reactivity

10.1 Reactivity	Stable under recommended storage conditions.
10.2 Chemical stability	No decomposition if stored and applied as directed.
10.3 Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
10.4 Conditions to avoid	Heat, flames and sparks.
10.5 Incompatible materials	Strong oxidizing agents, Alkali metals, Strong acids, Nitrates.
10.6 Hazardous decomposition products	Mainly carbon oxides occur under high temperature/fire conditions.

11. TOXICOLOGICAL INFORMATION

11.1 Information on the likely routes of exposure

Inhalation	May cause irritation to the respiratory system. May cause drowsiness or dizziness.
Ingestion	Irritating. May cause nausea, stomach pain and vomiting.
Skin contact	Causes mild skin irritation.
Eye contact	Causes serious eye irritation.

11.2 Symptoms related to the physical, chemical and toxicological characteristics

Inhalation	No data available.
Ingestion	No data available.
Skin contact	No data available.
Eye contact	No data available.



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11.3 Information on toxicological effects

Acute toxicity

Dermal LD 50, Rabbit: > 5000 mg/kg

Oral LD 50, Rat: >5000mg/kg

Inhalation LD 50, Rat, 4 h: >20 mg/L

Skin Corrosion/Irritation Causes mild skin irritation.

Serious Eye Damage/Eye Causes serious eye irritation.

Irritation

Respiratory or skin sensitization Not a skin sensitizer.

Germ cell mutagenicity

in vitro Ames test, Salmonella typhimurium; with and without metabolic activation: Did not show mutagenic effects (literature value)

in vivo No mutagenic components identified.

Carcinogenicity This substance has no evidence of carcinogenic properties.

Reproductive toxicity No components toxic to reproduction

Specific target organ toxicity

Single exposure The substance or mixture is classified as specific target organ toxicant, single exposure, category 3 with narcotic effects.

Repeated exposure No data available.

Aspiration hazard No data available.

Other effects No data available.

12. Ecological Information

12.1 Ecotoxicity

Fish

Specific substance(s)

toluene LC 50, 96 h: 50-70mg/l

LC 50, 96 h: 5-7 mg/l

LC 50, 96 h: 15-19 mg/l

LC 50, 96 h: 28 mg/l

LC 50, 96 h: 12 mg/l

Aquatic organisms

Specific substance(s)

toluene 3.78 mg/L after 2 days

Algae

Specific substance(s)



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toluene	ErC50, 134 mg/L
12.2 Persistence and degradability	
Persistence and degradability	Readily biodegradable..
12.3 Bioaccumulative potential	
Partition coefficient	2,73
n-octanol/water	
12.4 Mobility in soil	
Ecology - soil	No data available.
12.5 Results of PBT and vPvB assessment	This substance/mixture does not meet the PBT criteria of REACH regulation, annex XIII This substance/mixture does not meet the vPvB criteria of REACH regulation, annex XIII
12.6 Other adverse effects	No data available
13. Disposal considerations	
13.1 Waste Code	U112 - Ethyl Acetate - (RQ 5,000 LB).D001 - Ignitability (RQ 100 LB). This product has the RCRA characteristic of ignitability. Re-evaluation of the product may be required by the user at the time of disposal, since the product uses, transformations, mixtures, contamination, and spillage may change the classification.
13.2 Disposal methods	Dispose of only in accordance with local, state, and federal regulations. Do not contaminate any lakes, streams, ponds, groundwater or soil. No mixing with other waste. Leave chemicals in original containers.
13.3 Empty containers	Empty containers retain product residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Empty drums should be completely drained, triple-rinsed, properly bunged and promptly returned to a drum reconditioner, or properly disposed.

14. Transport Information

IATA (International Air Transport Association)

UN number	1294	
UN proper shipping name	Toluene	
Transport hazard class(es)		
Class	3	3
Label(s)	3	3



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Packing group	II
Material pollutant	No
Special precaution for user	When shipped in quantities greater than 5,000 lbs, RQ must be added to the shipping description.

IMDG (International Maritime Dangerous Goods)

UN number	1294
UN proper shipping name	Toluene

Transport hazard class(es)

Class 3

Label(s) 3

Packing group II

Material pollutant No

Special precaution for user When shipped in quantities greater than 5,000 lbs, RQ must be added to the shipping description.

14.1 Environmental hazards

MARPOL Annex III - Prevention of pollution by harmful substances

Marine pollutants (yes/no) no

14.2 Special precautions for user No data available.

14.3 Transport in bulk according to Annex II of MARPOL73/78 and IBC Code

Remarks No data available.

15. Regulatory Information

15.1.1. EU-Regulations

The following restrictions are applicable according to Annex XVII of the REACH Regulation (EC) No 1907/2006

3. Liquid substances or mixtures which are regarded as dangerous in accordance with Directive 1999/45/EC or are fulfilling the criteria for any

of the following hazard classes or categories set out in Annex I to

Regulation (EC) No 1272/2008

Toluene - Toluene

3(a) Substances or mixtures fulfilling the criteria for any of the following hazard classes or categories set out in Annex I to Regulation (EC) No 1272/2008: Hazard classes 2.1 to 2.4, 2.6 and 2.7, 2.8 types A and B, 2.9, 2.10, 2.12, 2.13 categories 1 and 2, 2.14 categories 1 and 2, 2.15 types A to F

Toluene - Toluene

3(b) Substances or mixtures fulfilling the criteria for any of the following hazard classes or categories set out in Annex I to Regulation (EC) No 1272/2008: Hazard classes 3.1 to 3.6,



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3.7 adverse effects on sexual function and fertility or on development, 3.8 effects other than narcotic effects, 3.9 and 3.10

Toluene - Toluene

40. Substances classified as flammable gases category 1 or 2, flammable liquids categories 1, 2 or 3, flammable solids category 1 or 2, substances and mixtures which, in contact with water, emit flammable gases, category 1, 2 or 3, pyrophoric liquids category 1 or pyrophoric solids category 1, regardless of whether they appear in Part 3 of Annex VI to Regulation (EC) No 1272/2008 or not.

Toluene - Toluene

Toluene is not on the REACH Candidate List

Toluene is not on the REACH Annex XIV List

VOC content : 100 %

National regulations

Germany

VwVwS Annex reference : Water hazard class (WGK) 2, hazard to waters (Classification according to VwVwS, Annex 1 or 2; ID No. 194)

12th Ordinance Implementing the Federal

Immission Control Act - 12.BImSchV : Is not subject of the 12. BImSchV (Hazardous Incident Ordinance)

Netherlands

Waterbezwaarlijkheid: 1 - Black list substance

SZW-lijst van kankerverwekkende stoffen : The substance is not listed

SZW-lijst van mutagene stoffen : The substance is not listed

NIET-limitatieve lijst van voor de voortplanting giftige stoffen – Borstvoeding : The substance is not listed

NIET-limitatieve lijst van voor de voortplanting giftige stoffen – Vruchtbaarheid: The substance is not listed

NIET-limitatieve lijst van voor de voortplanting giftige stoffen – Ontwikkeling: Toluene is listed

Inventory status

Australia	Inventory of Chemical Substances (AICS)	On or in compliance with the inventory
Japan	The inventory of existing and new chemical substances (ENCS)	On or in compliance with the inventory
EU	European Inventory of Existing Commercial Chemical Substances (EINECS)	On or in compliance with the inventory
EU	European List of Notified Chemical Substances (ELINCS)	On or in compliance with the inventory
EU	No-longer Polymers (NLP)	On or in compliance with the inventory
Canada	Domestic Substances List (DSL) Inventory	On or in compliance with the inventory
Philippines	Inventory of Chemicals/ Chemical Substances (PICCS)	On or in compliance with the inventory



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Korea	Existing Chemicals Inventory (KECI)	On or in compliance with the inventory
China	Inventory of Existing Chemical Substances (IECSC)	On or in compliance with the inventory
Mexico	National Inventory of Chemical Substances of Mexico (INSQ)	On or in compliance with the inventory
New Zealand	Inventory of Chemical Substances	On or in compliance with the inventory
Taiwan	National Existing Chemical Inventory (NECI)	On or in compliance with the inventory

16. Other Information

Hazard Ratings

	<u>Health</u>	<u>Flammability</u>	<u>Physical Hazard/ Instability</u>
HMIS	2	3	0
NFPA	2	3	0

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible

Date of the latest revision 2021/04/14

DISCLAIMER:

This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Information contained in this Safety Data Sheet is to the best of our knowledge and believed to be reliable but no representation, guarantee or warranties of any kind are made as to its accuracy, suitability for a particular application etc. It is up to the user/distributor to ensure that the information contained in the material safety data sheet is relevant to the product manufactured or sold as the case may be. Enerage Inc. makes no warranties, expressed or implied, in respect of the adequacy of this document for any particular purpose.

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