SAFETY DATA SHEET

Product: Semiconducting Single-Wall Carbon nanotubes in aromatic solution

Section 1: Product and Company Identification

Product Description: IsoSol-S100. Ultra high-purity (>99%), polymer-wrapped semiconducting single-walled carbon nanotubes in aromatic solution.

Use of the substance/Preparation: For laboratory research purposes.

Manufacturer: NanoIntegris Technologies

Address: c/o Raymor Industries Inc.
3765 La Vérendrye
Boisbriand, Quebec, J7H 1R8
CANADA

Emergency Contact: CHEMTREC
1-800-262-8200 (within the U.S.)
+1 703-741-5500 (Worldwide)

General Contact: +1-866-650-0482

Date Prepared: September 6, 2018

Section 2: Hazards Identification

Emergency Overview: May be harmful if swallowed. Avoid eye contact.

Target Organs: Bladder, Liver, Kidney, Brain

GHS Classification: Flammable liquids (Category 2)
Skin irritation (Category 2)
Reproductive toxicity (Category 2)
Specific target organ toxicity - single exposure (Category 3), Central nervous system
Specific target organ toxicity - repeated exposure (Category 2)
Aspiration hazard (Category 1)
Acute aquatic toxicity (Category 2)

GHS Label elements, including precautionary statements:

Pictograms:

Signal Word: Danger

Hazard Statement(s):
H225 Highly flammable liquid and vapour.
H304 May be fatal if swallowed and enters airways.
H315 Causes skin irritation.
H336 May cause drowsiness or dizziness.
H361 Suspected of damaging fertility or the unborn child.
SAFETY DATA SHEET

Product: Semiconducting Single-Wall Carbon nanotubes in aromatic solution

H373 May cause damage to organs through prolonged or repeated exposure.
H401 Toxic to aquatic life.

Precautionary statement(s):
P210 Keep away from heat/sparks/open flames/hot surfaces. -No smoking.
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P281 Use personal protective equipment as required.
P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P331 Do NOT induce vomiting.

Section 3: Composition and Information on Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>CAS#</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon nanotubes</td>
<td>308068-56-6</td>
<td>&lt;0.01%</td>
</tr>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>&gt;99%</td>
</tr>
<tr>
<td>Proprietary Polyfluorene Copolymer</td>
<td>248256-53-3</td>
<td>&lt;0.05 %</td>
</tr>
<tr>
<td>Mixture of Nickel and Iron and</td>
<td>7440-02-0</td>
<td>&lt;0.0005 %</td>
</tr>
<tr>
<td>Cobalt</td>
<td>7440-48-4</td>
<td></td>
</tr>
</tbody>
</table>

Section 4: First Aid Measures

Ingestion (Swallowed): Do NOT induce vomiting. Call local physician or poison control center.
Eye Contact: Flush thoroughly with water. Remove contact lenses if present after the first 5 minutes and continue flushing for several more minutes. Get medical attention of irritation persists.
Skin Contact: Wash with soap and water. If irritation develops and persists, get medical attention.
Inhalation (Breathing): If irritation is experienced, move to fresh air. Get medical attention if irritation or other symptoms develop and persist.

Section 5: Fire Fighting Measures

Conditions of flammability: Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.
Suitable extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Special protective equipment for firefighters: Wear self contained breathing apparatus for fire fighting if necessary.
Hazardous combustion products: Hazardous decomposition products formed under fire conditions - Carbon oxides
Explosion data - sensitivity to mechanical discharge: No data available
Explosion data - sensitivity to static discharge: No data available
Further information: Use water spray to cool unopened containers.

Section 6: Accidental Release Measures

Personal precautions: Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions: Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up: Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

Section 7: Handling and Storage

Handling: Minimize breathing of vapors and avoid prolonged or repeated contact with skin. Wear proper protective equipment. If ventilation is not efficient, wear proper respiratory equipment. Detailed information on handling carbon nanotubes may be found at the ASTM Standard E 2535-07, “Standard Guide for Handling Unbound Engineer Nanoscale Particles in Occupational Settings,” ASTM International, www.astm.org

Storage: Store in cool, dry, well-ventilated area away from all sources of ignition. “Empty” containers may retain product residue and can be hazardous. 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.


Section 8: Exposure Controls/ Personal Protection

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Occupational Exposure Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>20 ppm TWA (USA. ACGIH Threshold Limit Values (TLV)) 20 ppm TWA (Canada. British Columbia OEL)</td>
</tr>
<tr>
<td></td>
<td>50 ppm &amp; 188 mg/m³ TWA (Canada. Alberta, Occupational Health and Safety Code (table 2: OEL)</td>
</tr>
<tr>
<td></td>
<td>50 ppm &amp; 188 mg/m³ TWAEV (Québec. Regulation respecting occupational health and safety, Schedule 1, Part 1: Permissible exposure values for airborne contaminants)</td>
</tr>
<tr>
<td></td>
<td>20 ppm TWAEV (Canada. Ontario OELS’s) Visual impairment</td>
</tr>
<tr>
<td></td>
<td>Female reproductive Pregnancy loss 2010 Adoption</td>
</tr>
<tr>
<td></td>
<td>Substances for which there is a Biological Exposure Index or Indices (see BEI® section)</td>
</tr>
<tr>
<td></td>
<td>Not classifiable as a human carcinogen</td>
</tr>
</tbody>
</table>
SAFETY DATA SHEET

Product: Semiconducting Single-Wall Carbon nanotubes in aromatic solution

Dry carbon nanotubes

- NIOSH Exposure Limit Value: 0.01 mg/m³ (ACGIH)
- OSHA (PEL): No occupational limits established.
- German Maximale Arbeitsplatzkonzentration (MAK): 6 mg/m³
- British Occupational Exposure Limit (OEL): 3.5 mg/m³
- Italian Exposure Limit: 3.5 mg/m³ TWA; * 7 mg/m³ STEL**
- NEDO Projet “Research and Development of Nanoparticle Characterization Methods”: 0.03 mg/m³ (based on a 4 week test with full-body inhalation by Nakanishi et al., 2011).

* Time-weighted average ** Short-term exposure limit

The Following Controls are Recommended for Normal Consumer Use of this Product

**Engineering Controls:**
Use in a well-ventilated area. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Section 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

**Personal Protection:**

**Eye Protection:**
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin Protection:**
Avoid prolonged skin contact. Chemical resistant gloves recommended for operations where skin contact is likely.

**Respiratory Protection:**
None needed for normal use with adequate ventilation.

**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. Wash and dry hands.
Full contact
- Material: Fluorinated rubber Minimum layer thickness: 0.7 mm Break through time: 480 min
- Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)
- Splash contact
- Material: Fluorinated rubber Minimum layer thickness: 0.7 mm Break through time: 480 min
- Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

For Bulk Processing or Workplace Use the Following Recommended Controls:

**Engineering Controls:**
Use adequate general and local exhaust ventilation to maintain exposure levels below that of occupational exposure limits.

**Personal Protection:**

**Eye Protection:**
Safety goggles recommended where eye contact is possible.

**Skin Protection:**
Wear chemical resistant gloves.

**Protective Clothing/equipment:**
Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye and face- protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with, contact lenses.
SAFETY DATA SHEET

Product: Semiconducting Single-Wall Carbon nanotubes in aromatic solution

Respiratory Protection: None required if ventilation is adequate. Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. Follow OSHA 1910.134, ANSI Z88.2 and good Industrial Hygiene practice.

Work/ Hygiene Practices: Wash with soap and water after handling.

Section 9: Physical and Chemical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Liquid</td>
</tr>
<tr>
<td>Form</td>
<td>Liquid</td>
</tr>
<tr>
<td>Colour</td>
<td>Dark Brown</td>
</tr>
<tr>
<td>Solubility in Water</td>
<td>Limited Solubility. No data available.</td>
</tr>
<tr>
<td>Odor</td>
<td>Aromatic</td>
</tr>
<tr>
<td>Boiling Point</td>
<td>110-111 °C (230 - 232 °F)</td>
</tr>
<tr>
<td>Melting point/freezing point</td>
<td>-93 °C (-135 °F)</td>
</tr>
<tr>
<td>Flash point</td>
<td>4.0 °C – closed cup</td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>29.1 hPa (21.8 mmHg) at 20 °C</td>
</tr>
<tr>
<td>Ignition temperature</td>
<td>535 °C (995 °F)</td>
</tr>
<tr>
<td>Auto-ignition temperature</td>
<td>535.0 °C (995.0 °F)</td>
</tr>
<tr>
<td>Lower explosion limit</td>
<td>1.2 %(V)</td>
</tr>
<tr>
<td>Upper explosion limit</td>
<td>7 %(V)</td>
</tr>
<tr>
<td>Density</td>
<td>0.865 g/mL at 25 °C (77 °F)</td>
</tr>
</tbody>
</table>

Section 10: Stability and Reactivity

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stability</td>
<td>Stable</td>
</tr>
<tr>
<td>Hazardous Polymerization</td>
<td>Will not occur.</td>
</tr>
<tr>
<td>Conditions to Avoid</td>
<td>Heat, sparks, flames, and other sources of ignition. Extremely cold temperatures. Do not puncture or incinerate storage container.</td>
</tr>
<tr>
<td>Incompatibilities</td>
<td>Strong oxidizing agents.</td>
</tr>
<tr>
<td>Hazardous Decomposition</td>
<td>Hazardous decomposition products formed under fire conditions. - Carbon oxides. Other decomposition products - no data available.</td>
</tr>
</tbody>
</table>

Section 11: Toxicological Information

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute toxicity (toluene)</td>
<td>Oral LD50</td>
</tr>
<tr>
<td></td>
<td>LD50 Oral - rat - &gt; 5,580 mg/kg Inhalation LC50</td>
</tr>
<tr>
<td></td>
<td>LC50 Inhalation - rat - 4 h - 12,500 - 28,800 mg/m3 Dermal LD50</td>
</tr>
<tr>
<td></td>
<td>LD50 Dermal - rabbit - 12,196 mg/kg</td>
</tr>
<tr>
<td>Other information on acute toxicity no data available.</td>
<td></td>
</tr>
</tbody>
</table>
SAFETY DATA SHEET

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**Skin Toxicity (toluene):**
Skin corrosion/irritation
Skin - rabbit - Skin irritation - 24 h Serious eye damage/eye irritation no data available
Respiratory or skin sensitisation no data available

**Germ cell mutagenicity (toluene):**
Genotoxicity in vitro - rat - Liver DNA damage

**Carcinogenicity (toluene):**
IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

**Reproductive toxicity (toluene):**
Reproductive toxicity - rat - Inhalation
Paternal Effects: Spermatogenesis (including genetic material, sperm morphology, motility, and count). Experiments have shown reproductive toxicity effects in male and female laboratory animals.

**Teratogenicity (toluene):**
Developmental Toxicity - rat - Oral
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Damage to fetus possible
Suspected human reproductive toxicant

**Target Organ Toxicity (toluene):**
Specific target organ toxicity - single exposure (Globally Harmonized System) no data available
Specific target organ toxicity - repeated exposure (Globally Harmonized System) no data available

**Potential health effects (toluene):**
May be harmful if inhaled. Causes respiratory tract irritation. Vapours may cause drowsiness and dizziness.

**Inhalation Ingestion (toluene):**
May be harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage.

**Skin Eyes (toluene):**
May be harmful if absorbed through skin. Causes skin irritation. Causes eye irritation.

**Signs and Symptoms of Exposure (toluene):**
Lung irritation, chest pain, pulmonary edema, Inhalation studies on toluene have demonstrated the development of inflammatory and ulcerous lesions of the penis, prepuce, and scrotum in animals.

**Additional Information (toluene):**
RTECS: XS5250000

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**Section 12: Ecological Information (toluene)**

**Toxicity:**

- **Toxicity to fish**
  
  LC50 - Oncorhynchus mykiss (rainbow trout) - 7.63 mg/l - 96 h NOEC - Pimephales promelas (fathead minnow) - 5.44 mg/l - 7 d

- **Toxicity to daphnia and other aquatic invertebrates**
  
  EC50 - Daphnia magna (Water flea) - 8.00 mg/l - 24 h Immobilization EC50 - Daphnia magna (Water flea) - 6 mg/l - 48 h

- **Toxicity to algae**
  
  EC50 - Chlorella vulgaris (Fresh water algae) - 245.00 mg/l - 24 h
  
  EC50 - Pseudokirchneriella subcapitata (green algae) - 10.00 mg/l - 24 h
SAFETY DATA SHEET

Product: Semiconducting Single-Wall Carbon nanotubes in aromatic solution

Persistence and degradability
Biodegradability Result: - Readily biodegradable.
Bioaccumulative potential: no data available. Mobility in soil no data available
PBT and vPvB assessment: no data available

Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Toxic to aquatic life.

Section 13: Disposal Considerations

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

Section 14: Transport Information

DOT (US)
UN number: 1294 Class: 3 Packing group: II Proper shipping name: Toluene Reportable Quantity (RQ): 1000 lbs Marine pollutant: No Poison Inhalation Hazard: No

IMDG
UN number: 1294 Class: 3 Packing group: II EMS-No: F-E, S-D Proper shipping name: TOLUENE Marine pollutant: No

IATA
UN number: 1294 Class: 3 Packing group: II Proper shipping name: Toluene

Section 15: Regulatory Information

This product has been classified in accordance with the hazard criteria of the Hazardous Products Regulations (HPR) and the SDS contains all the information required by the HPR.

Section 16: Other Information

<table>
<thead>
<tr>
<th>Hazard Statement(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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<td>H304</td>
<td>May be fatal if swallowed and enters airways.</td>
</tr>
<tr>
<td>H315</td>
<td>Causes skin irritation.</td>
</tr>
<tr>
<td>H336</td>
<td>May cause drowsiness or dizziness.</td>
</tr>
<tr>
<td>H361</td>
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<table>
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<tr>
<th>H373</th>
<th>May cause damage to organs through prolonged or repeated exposure. Toxic to aquatic life.</th>
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<tbody>
<tr>
<td>H401</td>
<td></td>
</tr>
<tr>
<td>P210</td>
<td>Precautionary statement(s)</td>
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<td>P261</td>
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</table>

Disclaimer

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist. The information contained herein was not obtained from toxicology assays using our single-wall carbon nanotubes but gathered from literature.