Mn:ZnSe Nanocrystals in Toluene (600nm)

1. PRODUCT IDENTIFICATION

Chemical Name: Zinc/Manganese Selenide in Toluene (Doped Nanocrystals/D-dots)
Supplier: NN Crystal US Corporation 534 W Research Center Blvd., Ste 254 Fayetteville, AR 72701
Product Line: DD
Phone: 479.95.0662
Recommended Use: Research and development use only.

2. HAZARDS IDENTIFICATION

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

- Flammable liquids (Category 2), H225
- Acute toxicity, Oral (Category 3), H301
- Skin irritation (Category 2), H315
- Acute toxicity, Inhalation (Category 3), H331
- Reproductive toxicity (Category 2), H361
- Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336
- Specific target organ toxicity - repeated exposure (Category 2), H373
- Aspiration hazard (Category 1), H304
- Acute aquatic toxicity (Category 1), H400
- Acute aquatic toxicity (Category 2), H401
- Chronic aquatic toxicity (Category 1), H410

GHS Label Elements:

- Signal Word: Danger
- Hazardous Statements
  - H225: Highly flammable liquid and vapor.
  - H301 + H331: Toxic if swallowed or if inhaled
H304    May be fatal if swallowed and enters airways.
H315    Causes skin irritation. H336 May cause drowsiness or dizziness.
H373    May cause damage to organs through prolonged or repeated exposure.
H361    Suspected of damaging fertility or the unborn child.
H373    May cause damage to organs through prolonged or repeated exposure.
H401    Toxic to aquatic life.
H410    Very toxic to aquatic life with long lasting effects.

Precautionary Statements
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.
P233    Keep container tightly closed.
P240    Ground/bond container and receiving equipment.
P241    Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242    Use only non-sparking tools. P243 Take precautionary measures against static discharge.
P260    Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.
P264    Wash skin thoroughly after handling.
P270    Do not eat, drink or smoke when using this product.
P271    Use only outdoors or in a well-ventilated area.
P280    Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310 + P330 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician. Rinse mouth.
P303 + P361 + P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P303 + P361 + P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P311 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician.
P308 + P313 IF exposed or concerned: Get medical advice/ attention.
P314    Get medical advice/ attention if you feel unwell.
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P362    Take off contaminated clothing and wash before reuse.
P370 + P378 In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P391    Collect spillage.
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P403 + P235 Store in a well-ventilated place. Keep cool.
P405    Store locked up.
P501    Dispose of contents/ container to an approved waste disposal plant.

3. COMPOSITION/INFORMATION ON INGREDIENT (EACH VIAL)

Chemical Name: Zinc/Manganese Selenide (Doped Nanocrystals/D-dots)
Chemical Formula: Mn/ZnSe
Mixture Composition:

<table>
<thead>
<tr>
<th>Substance Name</th>
<th>CAS #</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZnSe</td>
<td>1315-09-9</td>
</tr>
<tr>
<td>MnSe</td>
<td>1313-22-0</td>
</tr>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
</tr>
<tr>
<td>Oleylamine</td>
<td>112-90-3</td>
</tr>
</tbody>
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4. FIRST AID MEASURES

Eye:
1. Flush immediately with warm water for at least 20 minutes
2. Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids
3. If pain persists or recurs seek medical attention
4. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel

Skin:
1. Removing contaminated clothing, shoes and leathery wearings
2. Washing affected area thoroughly with soap and water for at least 20 minutes
3. Call a physician if irritation develops or persists

Ingestion:
1. If spontaneous vomiting appears imminent or occurs, hold patient’s head down, lower than their hips to help avoid possible aspiration of vomits
2. If victim is conscious and alert, give 2-4 cupfuls of milk/water to dilute the substance in the stomach
3. Never give anything by mouth to an unconscious person
4. Don’t induce vomiting unless directed to by a medical person
5. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible, prior to initiating first aid procedures
6. Seek medical attention

Inhalation:
1. Remove from further exposure and flush thoroughly with air
2. Lay patient down. Keep warm and rested
3. Prosthesis such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures
4. If respiratory irritation seek immediate medical assistance and call a physician

Most important symptoms/effects, acute and delayed
Headache, fatigue, drowsiness, insomnia, anorexia and pain in limbs, nervousness, impairment of memory

5. FIRE FIGHTING MEASURES

Suitable extinguishing agents: Foam, CO2, dry chemical, water fog

Special Hazards:
1. Liquid and vapor are highly flammable.
2. Severe fire hazard when exposed to heat, flame and/or oxidizers.
3. Vapor may travel a considerable distance to source of ignition.
4. Heating may cause expansion and or decomposition leading to violent rupture of containers.
5. On combustion may emit toxic fumes of carbon monoxide.

**Protective equipment:** Wear self-contained respirator if necessary. Wear protective gloves.

6. ACCIDENTAL RELEASE MEASURES

**Person-related safety precautions:** Wear protective equipment. Keep unprotected persons away. Ensure adequate ventilation.

**Measures for environmental protection:** Do not allow material to be released to the environment without proper governmental permits.

**Measures for cleaning/collecting:**
1. Remove all ignition sources.
2. Clean up all spills immediately.
3. Avoid breathing vapors and contact with skin and eyes.
4. Control personal contact by using protective equipment.
5. Contain and absorb small quantities with vermiculite or other absorbent material.
6. Wipe up.
7. Collect residues in a flammable waste container.

7. HANDLING AND STORAGE

**Precautions for safe handling:**
1. Keep container tightly sealed. Store in refrigerator (2-8ºC) under dark conditions.
2. Wash thoroughly after handling
3. Use only in well ventilated area
4. Ground and bond containers when transferring
5. Use spark free tools and explosion proof equipment

**Conditions for safe storage, including any incompatibilities:**
1. Keep container tightly sealed. Store in refrigerator (2-8ºC) under dark conditions.
2. Do not store with acids or oxidizers.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

**Exposure for Toluene solvent**

**OSHA – Final PELs:** 200ppm TWA
**OSHA Ceiling:** 300ppm
**ACGIH:** 50ppm, skin-potential for cutaneous absorption
**NIOSH:** 100ppm TWA: 375 mg/m3 TWA; 550ppm IDLH

**Additional information about design of technical systems:** Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute.

**General protective and hygienic measures:** The usual precautionary measures for handling chemicals should be followed. Keep away from foodstuffs, beverages, and feed. Remove all soiled and contaminated clothing immediately. Wash hands before breaks and at the end of work. Avoid contact with the eyes and skin.

**Breathing equipment:** Use suitable respirator when high concentrations are present.

**Protection of hands:** Impervious gloves, check gloves using UV light after use to determine level of contamination.

**Eye protection:** Safety glasses
**Body protection:** Protective work clothing.

9. **PHYSICAL AND CHEMICAL PROPERTIES:**

**Form:** Liquid form. Crystalline powder, dissolved in a solvent

**Color:** Clear when dilute, Yellowish Clear when concentrated, White/Yellow in powder form.

**Odor:** aromatic petroleum odor. Crystalline powder is odorless

**Melting point/Melting range:** ~1100°C to bulk melting point of Mn:ZnSe crystals. Toluene: -95°C

**Boiling point/Boiling range:** Determined by solvent used; Toluene 110.6°C

**Sublimation temperature / start:** Not determined

**Flash point:** 4.4°C

**Ignition temperature:** 480°C

**Decomposition temperature:** Not determined

**Danger of explosion:** Dependent upon solvent used. Crystalline powder does not present an explosion hazard.

**Vapor pressure:** 22mmHg@20°C/68F

**Density:** 5.42 g/cm³ (crystal at 20 °C) for the nanocrystal powder if isolated. Toluene 0.86

**Solubility in / Miscibility with Polar Solvents:** Soluble when hydrophilic ligands are present

**Solubility in / Miscibility with Non-Polar Solvents:** Soluble when hydrophobic ligands are present

10. **STABILITY AND REACTIVITY**

**Reactivity:** Vapor is explosive when exposed to heat or flame

**Stability:** Stable at room temperature in closed containers under normal storage and handling conditions

**Incompatible materials:** Heat, flame, strong oxidizers, nitric and sulfuric acids, chlorine, nitrogen tetraoxide; will attack some forms of plastics, rubber, and coatings

**Hazardous decomposition products:** Carbon monoxide, carbon dioxide, hydrocarbons

**Thermal decomposition / conditions to be avoided:** Not determined, but temperature increases will affect the solvent used. Be aware of the necessary warnings for the specific solvent used.

**Dangerous reactions:** No dangerous reactions known for nanaocrystals but look up specifics for the solvent

11. **TOXICOLOGICAL INFORMATION**

(For Mn:ZnSe)

**Acute Toxicity:** Selenium may cause amyotrophic lateral sclerosis, bronchial irritation, gastrointestinal distress, vasopharyngeal irritation, garlic odor on breath and sweat, metallic taste, pallor, irritability, excessive fatigue, loss of fingernails and hair, pulmonary edema, anemia and weight loss.

Zinc and Manganese fumes may cause metal fume fever. Effects include dry throat, metallic taste, chest pain, dyspnea, rales and dry cough. Several hours later, chills many occur with lassitude, malaise, fatigue, headache, back pain, muscle cramps, blurred vision, nausea, fever, perspiration, vomiting and leukocytosis.

**Skin:** Irritant to skin and mucous membranes.

**Eye:** Irritating effect.

**Sensitization:** No sensitizing effects known.

**Additional toxicological information:** To the best of our knowledge the acute and chronic toxicity of this substance is not fully known. No classification data on carcinogenic properties of this material is available from the EPA, IARC, NTP, OSHA, or ACGIH.

**WARNING:** Many of the toxic effects of Mn:ZnSe nanocrystals are still being researched and are currently unknown at this point. Use at own risk.

(For Toluene)
Toxicity
LD50: <870mg/kg (rat, oral)
LC50: 6000ppm/6h (rat, inhalation)
Skin: Irritant to skin and mucous membranes.
Eye: Irritating effect.
Sensitization: No sensitizing effects known.
Additional toxicological information: Danger through skin absorption.
To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.
Target Organs: Lungs, Liver, Kidneys
EPA-B1: Probable human carcinogen, limited evidence of carcinogenicity from epidemiologic studies.
IARC-1: Carcinogenic to humans: sufficient evidence of carcinogenicity.
NTP-2: Reasonably anticipated to be a carcinogen: limited evidence from studies in humans or sufficient evidence from studies in experimental animals. Carcinogen as defined by OSHA.
ACGIH A2: Suspected human carcinogen: Agent is carcinogenic in experimental animals at dose levels, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) considered relevant to worker exposure. Available epidemiologic studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans.
Reproductive toxicity: Damage to fetus possible suspected human reproductive toxicant. 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.
Developmental Toxicity: Rat - Oral Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus)

12. ECOLOGICAL INFORMATION:

Ecotoxicity
LC50 (96 hr.) fish: 7.3-22.8mg/L
EC50 (48 hr.) water flea: --
Biocencentration factor (BCF): 1.67-380
Very toxic for fish.

General notes: Also poisonous for fish and plankton in water bodies. Do not allow material to be released into the environment without proper governmental permits. Very toxic for aquatic organisms.

13. DISPOSAL CONSIDERATIONS
Consult local or national regulations for proper disposal.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101
ID Number: UN1294
Hazard class: 3
Packing Group: II

Canadian Transportation of Dangerous Goods: UN1294, Class 3
Land Transport ADR/RID: UN1294, Class 3, Class Code F1, Pack group II
Air Transport IATA/ICAO: UN1294, Class or Division 3, Pack group II
Exceptions: 49 CFR 173.4
15. REGULATIONS

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

- Toluene       CAS-No. 108-88-3   Revision Date 2007-07-01

Massachusetts Right to Know Components
Toluene CAS-No.       CAS NO. 108-88-3   Revision Date 2007-07-01

Pennsylvania Right to Know Components
Toluene CAS-No.       CAS NO. 108-88-3   Revision Date 2007-07-01

New Jersey Right to Know Components
Toluene CAS-No.       CAS NO. 108-88-3   Revision Date 2007-07-01

California Prop. 65 Components
Toluene     CAS-No. 108-88-3   Revision Date 2007-07-01

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm:

- Toluene       CAS-No. 108-88-3   Revision Date 2007-07-01

16. OTHER INFORMATION

HMIS Rating

- Health hazard: 2
- Chronic Health Hazard: *
- Flammability: 3
- Physical Hazard: 0

NFPA Rating

- Health hazard: 2
- Fire Hazard: 3
- Reactivity Hazard: 0