SECTION 1: IDENTIFICATION OF THE PRODUCT AND OF THE COMPANY

1.1 Product identifiers
Product Name: ACS Material Monolayer WS₂ on SiO₂ Substrate
Brand: ACS Material LLC
CAS-No.: 12138-09-9 (WS₂); 60676-86-0 (SiO₂)

1.2 Relevant identified uses of the substance or mixture and uses advised against
Identified uses: Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet
Company: ACS MATERIAL LLC
959 E Walnut St., Suite 100
Pasadena, CA 91106
USA
Telephone: +1 (866)-227-0656
Fax: +1 (781)-518-0284

1.4 Emergency telephone number
Emergency Phone #: +1 (866)-227-0656

SECTION 2: HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture
GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin irritation (Category 2), H315
Eye irritation (Category 2A), H319
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram: ⚠️
Signal word: Warning
Hazard statement(s):
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
Precautionary statement(s)

P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves/ eye protection/ face protection.
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes.
   Remove contact lenses, if present and easy to do. Continue rinsing.
P312 Call a POISON CENTER or doctor/ physician if you feel unwell.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P337 + P313 If eye irritation persists: Get medical advice/ attention.
P362 Take off contaminated clothing and wash before reuse.
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P405 Store locked up.
P501 Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

None.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

<table>
<thead>
<tr>
<th>Substance name</th>
<th>ACS Material Monolayer WS₂ on SiO₂ Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS-No</td>
<td>12138-09-9</td>
</tr>
<tr>
<td>EC-No.</td>
<td>235-243-3</td>
</tr>
<tr>
<td>Synonyms</td>
<td>Tungsten disulfide</td>
</tr>
<tr>
<td></td>
<td>Tungsten sulfide</td>
</tr>
<tr>
<td>Molecular weight</td>
<td>247.97 g/mol</td>
</tr>
<tr>
<td>Linear formula</td>
<td>WS₂</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Substance name</th>
<th>SiO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS-No</td>
<td>60676-86-0</td>
</tr>
<tr>
<td>Synonyms</td>
<td>Silica, Quartz, Sand, Cristobalite</td>
</tr>
<tr>
<td>Molecular weight</td>
<td>60.08 g/mol</td>
</tr>
<tr>
<td>Linear formula</td>
<td>SiO₂</td>
</tr>
</tbody>
</table>

Hazardous ingredients

Chemical characterization: Tungsten disulfide, crystalline, synthetic, non fibrous
Components | Concentration | CAS No.
--- | --- | ---
Tungsten disulphide | <=100% | 12138-09-9

For the full text of the phrases mentioned in this Section, see Section 16.

Hazardous impurities: None known.

SECTION 4: FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11.

4.3 Indication of any immediate medical attention and special treatment needed
No data available.

SECTION 5: FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Sulphur oxides, Tungsten oxide, Silicon oxides.

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
The product itself does not burn.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: HANDLING AND STORAGE

7.1 Precautions for safe handling

Suitable extinguishing media
Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed. For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Handle and store under inert gas. Moisture sensitive.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

<table>
<thead>
<tr>
<th>Components</th>
<th>CAS-No.</th>
<th>Value</th>
<th>Control Parameters</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tungsten disulphide</td>
<td>12138-09-9</td>
<td>TWA</td>
<td>5.000000 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
</tr>
<tr>
<td>Remarks</td>
<td></td>
<td></td>
<td></td>
<td>Lower Respiratory Tract irritation varies.</td>
</tr>
</tbody>
</table>
8.2 Exposure controls
Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

8.3 Personal protective equipment

Eye/face protection
Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin 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.

Body Protection
Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place. Impervious clothing. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Do not let product enter drains.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

1) Appearance
   Form: crystalline
   Colour: colourless
2) Odour
No data available

3) Odour Threshold
No data available

4) pH
No data available

5) Melting point/freezing point
No data available

6) Initial boiling point and boiling range
No data available

7) Flash point
Not applicable

8) Evaporation rate
No data available

9) Flammability (solid, gas)
No data available

10) Upper/lower flammability or explosive limits
No data available

11) Vapour pressure
No data available

12) Vapour density
No data available

13) Relative density
7.500 g/cm$^3$ at 25 °C (77 °F)

14) Water solubility
No data available

15) Partition coefficient: n-octanol/water
No data available

16) Auto-ignition temperature
No data available

17) Decomposition temperature
No data available

18) Viscosity
No data available

19) Explosive properties
No data available

20) Oxidizing properties
No data available

**9.2 Other safety information**

Bulk density(SiO$_2$) 480 - 600 kg/m$^3$

**SECTION 10: STABILITY AND REACTIVITY**

10.1 **Reactivity**
No data available.

10.2 **Chemical stability**
Stable under recommended storage conditions.

10.3 **Possibility of hazardous reactions**
No data available.

10.4 **Conditions to avoid**
No data available.

10.5 **Incompatible materials**
Strong acids, strong oxidizing agents.

10.6 **Hazardous decomposition products**
Other decomposition products - No data available.

Hazardous decomposition products formed under fire conditions. - Tungsten trioxide.

In the event of fire: see section 5.
SECTION 11: TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

**WS$_2$:**
- No data available.
- Inhalation: No data available.
- Dermal: No data available.
- No data available.

**SiO$_2$:**
- LD$_{50}$ Oral - rat - $> 5,000$ mg/kg
- Inhalation: No data available.
- Dermal: No data available.
- No data available.

Skin corrosion/irritation
- No data available.

Serious eye damage/eye irritation
- No data available.

Respiratory or skin sensitisation
- No data available.

Germ cell mutagenicity
- No data available.

Carcinogenicity

**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.

**ACGIH:**
- No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

**NTP:**
- No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

**OSHA:**
- No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
- No data available.

**Specific target organ toxicity - single exposure**
- Inhalation - May cause respiratory irritation.

**Specific target organ toxicity - repeated exposure**
- No data available

Aspiration hazard
No data available

**Additional Information**
RTECS: Not available
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

**SECTION 12: ECOLOGICAL INFORMATION**

12.1 **Toxicity**
No data available.

12.2 **Persistence and degradability**
No data available.

12.3 **Bioaccumulative potential**
No data available.

12.4 **Mobility in soil**
No data available.

12.5 **Results of PBT and vPvB assessment**
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted.

12.6 **Other adverse effects**
No data available.

**SECTION 13: DISPOSAL CONSIDERATIONS**

13.1 **Waste treatment methods**

**Product**
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**

**UN number**
ADR/RID: -
IMDG: -
IATA: -

**UN proper shipping name**
ADR/RID: Not dangerous goods.
IMDG: Not dangerous goods.
IATA: Not dangerous goods.

**Transport hazard class(es)**
SECTION 15: REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Authorisations and/or restrictions on use

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

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Acute Health Hazard.

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

<table>
<thead>
<tr>
<th>Chemical</th>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tungsten disulphide</td>
<td>12138-09-9</td>
<td></td>
</tr>
<tr>
<td>Silicon dioxide</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

New Jersey Right To Know Components

<table>
<thead>
<tr>
<th>Chemical</th>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tungsten disulphide</td>
<td>12138-09-9</td>
<td></td>
</tr>
<tr>
<td>Silicon dioxide</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

SECTION 16: OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Eye Irrit.  Eye irritation
H315    Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
Skin Irrit Skin irritation
STOT SE Specific target organ toxicity - single exposure

HMIS Classification
Health hazard: 2
Chronic Health Hazard: 0
Flammability: 0
Physical Hazard: 0

NFPA Rating
Health hazard: 2
Fire Hazard: 0
Reactivity Hazard: 0

Disclaimer: ACS Material, LLC believes that the information in this Safety Data Sheet is accurate and represents the best and most current information available to us. ACS Material makes no representations or warranties either express or implied, regarding the suitability of the material for any purpose or the accuracy of the information contained within this document. Accordingly, ACS Material will not be responsible for damages resulting from use of or reliance upon this information.