SECTION 1: IDENTIFICATION OF THE PRODUCT AND OF THE COMPANY

1.1 Product identifiers
Product Name: ACS Material Monolayer MoS$_2$ on SiO$_2$ Substrate
Brand: ACS Material LLC
CAS-No.: 1317-33-5 (MoS$_2$); 60676-86-0 (SiO$_2$)

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

1.3 Details of the supplier of the safety data sheet
Company: ACS MATERIAL LLC
959 E Walnut Street, 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
Not a hazardous substance or mixture.

2.2 GHS Label elements, including precautionary statements
Not a hazardous substance or mixture.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS
None.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances
Substance name: ACS Material Monolayer MoS$_2$ on SiO$_2$ Substrate
CAS-No.: 1317-33-5
EC-No.: 215-263-9
Synonyms: Molybdenum Disulfide film
MoS\textsubscript{2} nanoplates

Molecular weight: 160.07 g/mol
Linear formula: MoS\textsubscript{2}

CAS-No: 60676-86-0
Synonyms: Silica, Quartz, Sand, Cristobalite

Molecular weight: 60.08 g/mol
Linear formula: SiO\textsubscript{2}

**Hazardous ingredients**
Chemical characterization: Molybdenum Disulfide, crystalline, synthetic, non-fibrous

<table>
<thead>
<tr>
<th>Components</th>
<th>Concentration</th>
<th>CAS No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MoS\textsubscript{2}</td>
<td>&lt;=100%</td>
<td>1317-33-5</td>
</tr>
</tbody>
</table>

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. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture
Silicon oxides.

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

5.4 Further information
No data available.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

6.2 Avoid dust formation. Avoid breathing vapours, mist or gas.
For personal protection see section 8.
Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
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
Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.

7.2 Conditions for safe storage, including any incompatibilities
Store in cool dry place. Keep container tightly closed in a dry and well-ventilated place.
Strongly hygroscopic. 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>Molybdenum(V) sulfide</td>
<td>1317-33-5</td>
<td>TWA 15.000000 mg/m³</td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA 10.000000 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA 3.000000 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA 15 mg/m³</td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA 10 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA 3 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PEL 10 mg/m³</td>
<td>California permissible exposure limits for chemical contaminants (Title 8, Article 107)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PEL 3 mg/m³</td>
<td>California permissible exposure limits for chemical contaminants (Title 8, Article 107)</td>
<td></td>
</tr>
</tbody>
</table>

8.2 Exposure controls

Appropriate engineering controls

General industrial hygiene practice.

8.3 Personal protective equipment

Eye/face protection

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.
Selected protective gloves must satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Full contact
Material: butyl-rubber
Minimum layer thickness: 0.3 mm
Break through time: 480 min
Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact
Material: Nature latex/chloroprene
Minimum layer thickness: 0.6 mm
Break through time: 30 min
Material tested: Lapren® (KCL 706 / Aldrich Z677558, Size M)

Data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail: sales@kcl.de
Test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**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 recommended. Type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. 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.

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**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
   - 7 - 8

5) Melting point/freezing point
   - 2,375 °C (4,307 °F)
<table>
<thead>
<tr>
<th>No.</th>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Initial boiling point and boiling range</td>
<td>No data available</td>
</tr>
<tr>
<td>7</td>
<td>Flash point</td>
<td>No data available</td>
</tr>
<tr>
<td>8</td>
<td>Evaporation rate</td>
<td>No data available</td>
</tr>
<tr>
<td>9</td>
<td>Flammability (solid, gas)</td>
<td>No data available</td>
</tr>
<tr>
<td>10</td>
<td>Upper/lower flammability or explosive limits</td>
<td>No data available</td>
</tr>
<tr>
<td>11</td>
<td>Vapour pressure</td>
<td>No data available</td>
</tr>
<tr>
<td>12</td>
<td>Vapour density</td>
<td>No data available</td>
</tr>
<tr>
<td>13</td>
<td>Relative density</td>
<td>5.060 g/cm³ at 25 °C (77 °F)</td>
</tr>
<tr>
<td>14</td>
<td>Water solubility</td>
<td>No data available</td>
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<tr>
<td>15</td>
<td>Partition coefficient: n-octanol/water</td>
<td>No data available</td>
</tr>
<tr>
<td>16</td>
<td>Auto-ignition temperature</td>
<td>No data available</td>
</tr>
<tr>
<td>17</td>
<td>Decomposition temperature</td>
<td>No data available</td>
</tr>
<tr>
<td>18</td>
<td>Viscosity</td>
<td>No data available</td>
</tr>
<tr>
<td>19</td>
<td>Explosive properties</td>
<td>No data available</td>
</tr>
<tr>
<td>20</td>
<td>Oxidizing properties</td>
<td>No data available</td>
</tr>
</tbody>
</table>

9.2 Other safety information

Bulk density (SiO₂) 480 - 600 kg/m³

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
Heat, flames, sparks, exposure to solarization and rain.

10.5 Incompatible materials
Hydrogen peroxide, oxidizing agents, strong oxidizing agents.

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions: Sulphur oxides, Molybdenum oxides.

Other decomposition products - No data available.
In the event of fire: see section 5.
SECTION 11: TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

**Acute toxicity**

**MoS₂:**
LC₅₀ Inhalation: > 2,820 mg/m³ (Rat 4 h)
Remarks: Lungs, Thorax, or Respiration: Other changes.
Dermal: No data available.
No data available.

**SiO₂:**
LD₅₀ Oral - rat - > 5,000 mg/kg
Inhalation: no data available
Dermal: 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**

**International Agency for Research on Cancer (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.

**American Conference of Governmental Industrial Hygienists (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.

**National Toxicology Program (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.

**Occupational Safety and Health Administration (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**
No data available.

**Specific target organ toxicity - repeated exposure**
No data available.
Aspiration hazard
No data available

Additional Information
RTECS: QA4697000
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)
ADR/RID: - IMDG: - IATA: -

Packaging group
ADR/RID: - IMDG: - IATA: -

Environmental hazards
ADR/RID: no IMDG Marine pollutant: no IATA: no

Special precautions for user
No data available.

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 Hazardsc
No SARA Hazards.

Massachusetts Right To Know Components

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1317-33-5</td>
<td>1993-04-24</td>
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</tbody>
</table>

Pennsylvania Right To Know Components

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1317-33-5</td>
<td>1993-04-24</td>
</tr>
</tbody>
</table>

Silicon dioxide

New Jersey Right To Know Components

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1317-33-5</td>
<td>1993-04-24</td>
</tr>
</tbody>
</table>

Silicon dioxide

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

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

NFPA Rating
Health hazard: 0
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.