SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier
Trade name/designation: FK9621

Other means of identification: RuO2 Dickschichtpaste für AlN FK9621

Article No.: 10055

1.2. Relevant identified uses of the substance or mixture and uses advised against
Use of the substance/mixture: Dickschichtpaste

Relevant identified uses:
- Sector of uses [SU]
  - SU 3: Industrial uses: Uses of substances as such or in preparations at industrial sites
- Product Categories [PC]
  - PC 9a: Coatings and paints, thinners, paint removers
- Process categories [PROC]
  - PROC 10: Roller application or brushing
- Environmental release categories [ERC]
  - ERC 5: Industrial use resulting in inclusion into or onto a matrix
- Article categories [AC]
  - AC 0: Other Articles

1.3. Details of the supplier of the safety data sheet
Supplier (manufacturer/importer/only representative/downstream user/distributor):
Fraunhofer IKTS
Intelligente Mikrosysteme
Winterbergstraße 28
01277 Dresden
Germany

Telephone: +49-351-2553-7916
Telefax: +49-351-2554-236
E-mail: service@ikts-tfc.de
Website: www.ikts.fraunhofer.de
E-mail (competent person): service@ikts-tfc.de

1.4. Emergency telephone number
Richard Schmidt, +49-351-2553-7916/-7518 (Only available during office hours.)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture
Classification according to Regulation (EC) No 1272/2008 [CLP]:

<table>
<thead>
<tr>
<th>Hazard classes and hazard categories</th>
<th>Hazard statements</th>
<th>Classification procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin corrosion/irritation (Skin Irrit. 2)</td>
<td>H315: Causes skin irritation.</td>
<td></td>
</tr>
<tr>
<td>Serious eye damage/eye irritation (Eye Irrit. 2)</td>
<td>H319: Causes serious eye irritation.</td>
<td></td>
</tr>
<tr>
<td>Acute toxicity (inhalative) (Acute Tox. 4)</td>
<td>H332: Harmful if inhaled.</td>
<td></td>
</tr>
<tr>
<td>STOT-single exposure (STOT SE 3)</td>
<td>H335: May cause respiratory irritation.</td>
<td></td>
</tr>
</tbody>
</table>
FK9621

2.2. Label elements
Labelling according to Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms:

![GHS07]
Exclamation mark

Signal word: Warning

<table>
<thead>
<tr>
<th>hazard statements for health hazards</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H315 Causes skin irritation.</td>
<td></td>
</tr>
<tr>
<td>H319 Causes serious eye irritation.</td>
<td></td>
</tr>
<tr>
<td>H332 Harmful if inhaled.</td>
<td></td>
</tr>
<tr>
<td>H335 May cause respiratory irritation.</td>
<td></td>
</tr>
</tbody>
</table>

Supplemental Hazard information (EU):

Precautionary statements Prevention

P280 Wear protective gloves/protective clothing/eye protection/face protection.

Precautionary statements Response

P302 + P352 IF ON SKIN: Wash with plenty of water/soap.

P305 + P351 + P38 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P332 + P313 If skin irritation occurs: Get medical advice/attention.

Precautionary statements Storage

P403 + P233 Store in a well-ventilated place. Keep container tightly closed.

Precautionary statements Disposal

P501 Dispose of contents/container to Dispose of waste according to applicable legislation.

Special rules for supplemental label elements for certain mixtures:

34.7 % percent of the mixture consists of ingredient(s) of unknown acute toxicity (oral).

61.5 % percent of the mixture consists of ingredient(s) of unknown acute toxicity (dermal).

61.5 % percent of the mixture consists of ingredient(s) of unknown acute toxicity (inhalative).

100.0 % percent of the mixture consists of components of unknown hazards to the aquatic environment.

2.3. Other hazards

No data available

SECTION 3: Composition / information on ingredients

3.2. Mixtures
Description:
Precious metals, glass and inorganic additives embedded in an organic vehicle.
SAFETY DATA SHEET
according to Regulation (EC) No. 1907/2006 (REACH)
Revision date: 15-Sep-2015
Print date: 18-Sep-2015
Version: 4
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Hazardous ingredients / Hazardous impurities / Stabilisers:

<table>
<thead>
<tr>
<th>product identifiers</th>
<th>Substance name</th>
<th>Classification according to Regulation (EC) No 1272/2008 [CL P]</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS No.: 12036-10-1</td>
<td>ruthenium (IV) oxide</td>
<td>STOT SE 3, Ox. Sol. 2, Acute Tox. 4, Eye Irrit. 2</td>
<td>21 – 36 Wt %</td>
</tr>
<tr>
<td>EC No.: 234-840-6</td>
<td></td>
<td>⚠️ Danger H272-H319-H332-H335</td>
<td></td>
</tr>
<tr>
<td>CAS No.: 8000-41-7</td>
<td>Terpineol</td>
<td>Skin Irrit. 2, Eye Irrit. 2</td>
<td>16 – 27 Wt %</td>
</tr>
<tr>
<td>EC No.: 232-268-1</td>
<td></td>
<td>⚠️ Warning H315-H319</td>
<td></td>
</tr>
<tr>
<td>CAS No.: 1313-13-9</td>
<td>manganese dioxide</td>
<td>Acute Tox. 4</td>
<td>2 – 4 Wt %</td>
</tr>
<tr>
<td>EC No.: 215-202-6</td>
<td></td>
<td>⚠️ Warning H302-H332</td>
<td></td>
</tr>
</tbody>
</table>

Full text of H- and EUH-phrases: see section 16.

SECTION 4: First aid measures

4.1. Description of first aid measures

General information:
In case of accident or unwellness, seek medical advice immediately (show directions for use or safety data sheet if possible). Remove victim out of the danger area. Remove contaminated, saturated clothing. If unconscious place in recovery position and seek medical advice. Do not leave affected person unattended.

Following inhalation:
Provide fresh air. In case of respiratory tract irritation, consult a physician. Get medical advice/attention. Get medical advice/attention if you feel unwell.

In case of skin contact:
After contact with skin, wash immediately with plenty of water and soap. If skin irritation or rash occurs: Get medical advice/attention. Take off immediately all contaminated clothing.

After eye contact:
Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

After ingestion:
Rinse mouth. Let water be drunken in little sips (dilution effect). Get medical advice/attention if you feel unwell.

Self-protection of the first aider:
Use personal protection equipment. No direct artificial respiration to be given by first aider.

4.2. Most important symptoms and effects, both acute and delayed
Skin corrosion/irritation Serious eye damage/eye irritation Irritation to respiratory tract

4.3. Indication of any immediate medical attention and special treatment needed
Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media:
Water spray jet, alcohol resistant foam, Extinguishing powder, Carbon dioxide (CO2). Co-ordinate firefighting measures to the fire surroundings.

Unsuitable extinguishing media:
High power water jet

5.2. Special hazards arising from the substance or mixture
In case of fire may be liberated: CO, CO2

Hazardous combustion products:
In case of fire: Gases/vapours, toxic
5.3. Advice for firefighters
Wear a self-contained breathing apparatus and chemical protective clothing.

5.4. Additional information
Collect contaminated fire extinguishing water separately. Do not allow entering drains or surface water.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
6.1.1. For non-emergency personnel
Personal precautions:
Remove persons to safety.
Protective equipment:
Wear protective gloves/protective clothing/eye protection/face protection.
6.1.2. For emergency responders
Personal protection equipment:
Personal protection equipment: see section 8

6.2. Environmental precautions
Do not allow to enter into surface water or drains.

6.3. Methods and material for containment and cleaning up
For containment:
Collect spillage. Measures to prevent aerosol and dust generation Wet clean or vacuum up solids.
For cleaning up:
Water (with cleaning agent)

6.4. Reference to other sections
Safe handling: see section 7 Personal protection equipment: see section 8 Disposal: see section 13

6.5. Additional information
Use appropriate container to avoid environmental contamination.

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Protective measures
Advises on safe handling:
Wear personal protection equipment (refer to section 8).
Fire prevent measures:
The formation of combustible vapours is possible at temperatures above: 91 °C
Measures to prevent aerosol and dust generation:
Dust should be exhausted directly at the point of origin.
Environmental precautions:
Do not allow to enter into surface water or drains.
Advises on general occupational hygiene
When using do not eat, drink or smoke. Avoid contact with eyes and skin.

7.2. Conditions for safe storage, including any incompatibilities
Technical measures and storage conditions:
Keep container tightly closed in a cool, well-ventilated place.
Packaging materials:
Keep/Store only in original container.
Requirements for storage rooms and vessels:
Keep container tightly closed.
Hints on storage assembly:
Prohibition on mixed storage has to be followed
Storage class: 11 – Combustible solids that cannot be assigned to any of the above storage classes
Further information on storage conditions:
Keep in a cool, well-ventilated place.

7.3. Specific end use(s)
Recommendation:
Observe technical data sheet.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters
No data available

8.2. Exposure controls
8.2.1. Appropriate engineering controls
Technical measures and the application of suitable work processes have priority over personal protection equipment.

8.2.2. Personal protection equipment

Eye/face protection:
Eye glasses with side protection

Skin protection:
Tested protective gloves must be worn DIN EN 374 Suitable material: NBR (Nitrile rubber) 0,4 mm. Breakthrough time (maximum wearing time) 480 min. In the case of wanting to use the gloves again, clean them before taking off and air them well.

Respiratory protection:
If technical exhaust or ventilation measures are not possible or insufficient, respiratory protection must be worn. Particle filter device (DIN EN 143)

8.2.3. Environmental exposure controls
See section 7. No additional measures necessary.

8.3. Additional information
No data available

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance
Physical state: solid
Odour: not determined

Colour: black

Safety relevant basis data

<table>
<thead>
<tr>
<th>parameter</th>
<th>at °C</th>
<th>Method</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>not determined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melting point/freezing point</td>
<td>≥ -35.9 – ≤ -28.2 °C</td>
<td>Overtaken from organic solvent of the paste (CAS#8000-41-7)</td>
<td></td>
</tr>
<tr>
<td>Freezing point</td>
<td>not determined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial boiling point and boiling range</td>
<td>≥ 214 – ≤ 217 °C</td>
<td>Overtaken from organic solvent of the paste (CAS#8000-41-7)</td>
<td></td>
</tr>
<tr>
<td>Decomposition temperature (°C):</td>
<td>not determined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash point</td>
<td>88 °C</td>
<td>closed cup</td>
<td>Overtaken from organic solvent of the paste (CAS#8000-41-7)</td>
</tr>
<tr>
<td>Evaporation rate</td>
<td>not determined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ignition temperature in °C</td>
<td>= 264 °C</td>
<td></td>
<td>Overtaken from organic solvent of the paste (CAS#8000-41-7)</td>
</tr>
<tr>
<td>Upper/lower flammability or explosive limits</td>
<td>not determined</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FK9621

<table>
<thead>
<tr>
<th>parameter</th>
<th>at °C</th>
<th>Method</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapour pressure</td>
<td>0.24 hPa</td>
<td>20 °C</td>
<td>Overtaken from organic solvent of the paste (CAS#8000-41-7)</td>
</tr>
<tr>
<td>Vapour density</td>
<td>not determined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>2.2 g/cm³</td>
<td>25 °C</td>
<td>calculated from ingredients</td>
</tr>
<tr>
<td>Bulk density</td>
<td>not determined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water solubility (g/L)</td>
<td>2.42 g/l</td>
<td>20 °C</td>
<td>Overtaken from organic solvent of the paste (CAS#8000-41-7)</td>
</tr>
<tr>
<td>Partition coefficient: n-octanol/water</td>
<td>2.6</td>
<td></td>
<td>Overtaken from organic solvent of the paste (CAS#8000-41-7)</td>
</tr>
<tr>
<td>Dynamic viscosity</td>
<td>≥ 150 – ≤ 250 Pa*s</td>
<td>25 °C</td>
<td>Brookfield SC4-14/-6R // n=10 U/min</td>
</tr>
<tr>
<td>Kinematic viscosity</td>
<td>not determined</td>
<td>40 °C</td>
<td></td>
</tr>
</tbody>
</table>

9.2. Other information
No data available

SECTION 10: Stability and reactivity

10.1. Reactivity
Moisture-sensitive. Risk of explosion if heated under confinement.

10.2. Chemical stability
The product is chemically stable under recommended conditions of storage, use and temperature.

10.3. Possibility of hazardous reactions
No known hazardous reactions.

10.4. Conditions to avoid
Do not store at temperatures above 30°C

10.5. Incompatible materials
Acid, Alkali (lye), Oxidising agent, strong

10.6. Hazardous decomposition products
No known hazardous decomposition products.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

<table>
<thead>
<tr>
<th>CAS No.</th>
<th>Substance name</th>
<th>Toxicological information</th>
</tr>
</thead>
<tbody>
<tr>
<td>12036-10-1</td>
<td>ruthenium (IV) oxide</td>
<td>LD₅₀ oral: 4,580 mg/kg (Rat)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LD₅₀ dermal: &gt;2,000 mg/kg (Rabbit)</td>
</tr>
<tr>
<td>8000-41-7</td>
<td>Terpineol</td>
<td>LD₅₀ oral: &gt;4,300 mg/kg (Ratte)</td>
</tr>
</tbody>
</table>

Acute inhalation toxicity:
Toxic if inhaled.

Skin corrosion/irritation:
Causes severe skin burns and eye damage.

Eye damage/irritation:
Causes serious eye damage.

STOT-single exposure:
The classification criteria for this hazard class are not met by definition.

SECTION 12: Ecological information

12.1. Toxicity
No data available
12.2. Persistence and degradability

<table>
<thead>
<tr>
<th>CAS No.</th>
<th>Substance name</th>
<th>Biodegradation</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>12036-10-1</td>
<td>ruthenium (IV) oxide</td>
<td>not determined</td>
<td>SDB für Rutheniumoxid von Heraeus Deutschland GmbH &amp; Co. KG, Version 7, überarbeitet am: 09.04.2013</td>
</tr>
<tr>
<td>8000-41-7</td>
<td>Terpineol</td>
<td>not determined</td>
<td>Classification according to VwVwS, Annex 3.</td>
</tr>
<tr>
<td>1313-13-9</td>
<td>manganese dioxide</td>
<td>not determined</td>
<td>WGK-Einstufung nach Kenn-Nummer 7.145 - VwVwS</td>
</tr>
</tbody>
</table>

12.3. Bioaccumulative potential

<table>
<thead>
<tr>
<th>CAS No.</th>
<th>Substance name</th>
<th>Log K&lt;sub&gt;OC&lt;/sub&gt;</th>
<th>Bioconcentration factor (BCF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000-41-7</td>
<td>Terpineol</td>
<td>2.6</td>
<td></td>
</tr>
</tbody>
</table>

Partition coefficient: n-octanol/water:
= 2.6; Remark: Overtaken from organic solvent of the paste (CAS#8000-41-7)

12.4. Mobility in soil
No data available

12.5. Results of PBT and vPvB assessment

<table>
<thead>
<tr>
<th>CAS No.</th>
<th>Substance name</th>
<th>Results of PBT and vPvB assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>12036-10-1</td>
<td>ruthenium (IV) oxide</td>
<td>—</td>
</tr>
<tr>
<td>8000-41-7</td>
<td>Terpineol</td>
<td>—</td>
</tr>
<tr>
<td>1313-13-9</td>
<td>manganese dioxide</td>
<td>—</td>
</tr>
</tbody>
</table>

12.6. Other adverse effects
No data available

SECTION 13: Disposal considerations

13.1. Waste treatment methods
Handle contaminated packages in the same way as the substance itself.

13.1.1. Product/Packaging disposal
Waste codes/waste designations according to EWC/AVV

<table>
<thead>
<tr>
<th>Waste code product:</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 05 06 *</td>
</tr>
<tr>
<td>laboratory chemicals consisting of or containing dangerous substances including mixtures of laboratory chemicals</td>
</tr>
</tbody>
</table>

*: Evidence for disposal must be provided.

Waste treatment options

Appropriate disposal / Product:
Dispose of waste according to applicable legislation. Consult the appropriate local waste disposal expert about waste disposal.

Appropriate disposal / Package:
Completely emptied packages can be recycled.

13.2. Additional information
No data available

SECTION 14: Transport information
No dangerous good in sense of these transport regulations.

14.1. UN-No.
not relevant

14.2. UN proper shipping name
not relevant
14.3. Transport hazard class(es)
not relevant

14.4. Packing group
not relevant

14.5. Environmental hazards
not relevant

14.6. Special precautions for user
not relevant

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
not relevant

SECTION 15: Regulatory information

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

15.1.1. EU legislation
No data available

15.1.2. National regulations

[DE] National regulations

Restrictions of occupation
5 MuSchRiV. 22 J ArbSchG.

Water hazard class (WGK)
WGK:
2 - deutlich wassergefährdend

Source:
Classification according to VwVwS, Annex 3.

15.2. Chemical Safety Assessment
Chemical safety assessments for substances in this mixture were not carried out.

15.3. Additional information
No data available

SECTION 16: Other information

16.1. Indication of changes
No data available

16.2. Abbreviations and acronyms
No data available

16.3. Key literature references and sources for data
GESTIS material database of German "IFA", accessed on 15.09.2015

16.4. Classification for mixtures and used evaluation method according to regulation (EC) No 1272/2008 [CLP]
Classification according to Regulation (EC) No 1272/2008 [CLP]:

<table>
<thead>
<tr>
<th>Hazard classes and hazard categories</th>
<th>Hazard statements</th>
<th>Classification procedure</th>
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</thead>
<tbody>
<tr>
<td>Skin corrosion/irritation (Skin Irrit. 2)</td>
<td>H315: Causes skin irritation.</td>
<td></td>
</tr>
<tr>
<td>Serious eye damage/eye irritation (Eye Irrit. 2)</td>
<td>H319: Causes serious eye irritation.</td>
<td></td>
</tr>
<tr>
<td>Acute toxicity (inhalative) (Acute Tox. 4)</td>
<td>H332: Harmful if inhaled.</td>
<td></td>
</tr>
</tbody>
</table>
Hazard classes and hazard categories | Hazard statements | Classification procedure
--- | --- | ---
STOT-single exposure  (STOT SE 3) | H335: May cause respiratory irritation. | 

### 16.5. Relevant R-, H- and EUH-phrases (Number and full text)

<table>
<thead>
<tr>
<th>Hazard statements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H272</td>
<td>May intensify fire; oxidiser.</td>
</tr>
<tr>
<td>H302</td>
<td>Harmful if swallowed.</td>
</tr>
<tr>
<td>H315</td>
<td>Causes skin irritation.</td>
</tr>
<tr>
<td>H319</td>
<td>Causes serious eye irritation.</td>
</tr>
<tr>
<td>H332</td>
<td>Harmful if inhaled.</td>
</tr>
<tr>
<td>H335</td>
<td>May cause respiratory irritation.</td>
</tr>
</tbody>
</table>

### 16.6. Training advice

No data available

### 16.7. Additional information

The above information describes exclusively the safety requirements of the product and is based on our present-day knowledge. The information is intended to give you advice about the safe handling of the product named in this safety data sheet, for storage, processing, transport and disposal. The information cannot be transferred to other products. In the case of mixing the product with other products or in the case of processing, the information on this safety data sheet is not necessarily valid for the new made-up material.