Hydrogen Leak Detection Sensor Database

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Outline

• Background information
• Overview of database details
• Database Snapshot
• Sensor types
• Examples
• Technology use
• Acknowledgements
Background Information

• NASA remains interested in improving its ability to detect and assess hydrogen gas leaks in its space applications

• MSFC/EV43 looks to support the Technology Evaluation for Environmental Risk Mitigation (TEERM) activities
  – Surveyed existing hydrogen leak detection sensors
  – Received input from other NASA centers:
    • Glenn Research Center (GRC)
    • Kennedy Space Center (KSC)
    • White Sands Test Facility (WSTF)
Overview

- Hydrogen Leak Detection Database Specifics
  - Manufacturer
  - Sensor specification sheet
  - Target gas (hydrogen)
  - Concentration range (ppm or % of lower flammable limit)
  - Operating temperature
  - Dimensions
  - Weight
  - Manufacturer website
  - Technology use
  - General notes about the sensor
## Database Snapshot

<table>
<thead>
<tr>
<th>#</th>
<th>Manufacturer</th>
<th>Sensor/Detector Specification Sheet</th>
<th>Target Gas</th>
<th>Concentration Range</th>
<th>Operation Temperature Range (°C)</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AppliedSensor Inc</td>
<td><strong>HLS-440</strong></td>
<td>Hydrogen (H2)</td>
<td>0 - 44,000 ppm; 0 - 4.4 % H2 in air</td>
<td>-40 -&gt; +110 °C</td>
<td>82.2 x 42 x 17.3 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#</th>
<th>Manufacturer</th>
<th>Weight</th>
<th>Website</th>
<th>Technology Use</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AppliedSensor Inc</td>
<td>50 g</td>
<td><a href="http://www.appliedsensor.com/">http://www.appliedsensor.com/</a></td>
<td>H2 Storage/Fueling Facility; Test Area</td>
<td>The HLS-440 Hydrogen Leak Sensor incorporates a heated field-effect transistor with a catalytic metal gate stack as the gas-sensing layer.</td>
</tr>
</tbody>
</table>

The HLS-440 Hydrogen Leak Sensor incorporates a heated field-effect transistor with a catalytic metal gate stack as the gas-sensing layer.
Sensor Types

- Microelectromechanical Systems (MEMS)
- Dye
- Electrochemical
- Catalytic

<table>
<thead>
<tr>
<th>#</th>
<th>H2 Detection Approach</th>
<th>Mass (g)</th>
<th>Power (mW)</th>
<th>Sensitivity (ppm)</th>
<th>Accuracy at 2 % (%)</th>
<th>Inert/Cryogenic Operation</th>
<th>Response Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H2 MEMS</td>
<td>72</td>
<td>300</td>
<td>10</td>
<td>&lt; 2</td>
<td>Yes</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>2</td>
<td>Dye</td>
<td>370</td>
<td>4000</td>
<td>15</td>
<td>3</td>
<td>No</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>Electrochemical</td>
<td>500</td>
<td>2400</td>
<td>2</td>
<td>0.0001</td>
<td>No</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>Catalytic</td>
<td>975</td>
<td>&lt; 1000</td>
<td>15</td>
<td>3</td>
<td>No</td>
<td>&lt; 12</td>
</tr>
</tbody>
</table>
Sensor Type Examples

• Microelectromechanical Systems (MEMS) Device
  – GRC/Makel Engineering Sensor Unit
  – Kebaili Corporation – KHS-200 MEMS Micro-Pellistor Hydrogen Sensor

• Dye
  – Element One Chemochromic Sensing Material

• Electrochemical
  – Air Test Technologies – TR3200 Electrochemical Gas Sensor
  – Honeywell – Hydrogen Sensor Switch
  – Sensidyne, LP – Part No. 101236-D-1 H2 Sensor

• Catalytic
  – AppliedSensor Inc – HLS-440
  – Neodym Technologies Inc – ProtiSen - Catalytic Hydrogen Gas Sensor
  – US Industrial Products Co., Inc. – USI Catalytic H2 Sensor Model 7100
Technology Use

• Currently, there are 65 hydrogen leak detection sensors in the database.

• An attempt was made to determine the potential uses for each sensor.
  – Ground (Storage/Fueling Facility or Test Area)
  – Vehicle

• Most were determined to be used for ground purposes only.
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