It all started in 1957 …

Japan Synthetic Rubber was created by the Japanese government to produce synthetic rubber for making car tires ….

JSR Corporation today

Since 1957 JSR has developed a unique expertise in the field of polymer chemistry.

We are a $4 billion leading supplier of advanced polymer materials with more than 5000 employees.

We have a Global Supply Network

- Three companies operate the business under “Global One Concept/Strategy”
- Local agents, warehouses and support
- Our goal: To collaborate closely with global technology leaders!
- Semiconductor and Display Materials
- JSR Corp., Yokkaichi Full-range of fine chemical products
- JSR Micro Inc., USA New materials
- JSR Micro N.V.

Lithium Ion Capacitor (JME-LIC)

Introduction JSR Micro’s sister company

ULTIMO Lithium Ion Capacitor

Elektrobus conference
Esslingen, June 19th, 2009
Comparing LIC to other technologies

<table>
<thead>
<tr>
<th>Energy Density [Wh/kg]</th>
<th>Power Density [kW/kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
<td>0.1</td>
</tr>
<tr>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>10</td>
<td>10.0</td>
</tr>
<tr>
<td>100</td>
<td>100.0</td>
</tr>
<tr>
<td>1000</td>
<td>1000.0</td>
</tr>
</tbody>
</table>

**LIC is a Capacitor, not a battery**

- **Battery**: Based on electrochemical reactions. → Slow charge/discharge rate.
- **Capacitor**: Based on electrostatic induction. → Rapid charge/discharge rate.

**Concept of Lithium-ion Capacitor**

- **Graphite**
- **Electrolyte**
- **LiCoO2**
- **Activated Carbon**
- **Li-doped Carbon**
- **Electrolyte**
- **Activated Carbon**

**Safe for transport, no Hydrogen formation by the solvent**

**Cell Dimension of Li-ion Capacitor**

- **1000F (106×138×4.5 mm) / 113 gram**
- **2000F (106×138×8.5 mm) / 208 gram**
- **500F (52×66×8.3 mm) / 50 gram**

**Very small, light weight device**

**JM Energy Yamanashi HQ Plant**

**LIC Cell Performance (500,1000, 2000F)**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>500F</th>
<th>1000F</th>
<th>2000F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>3.8V</td>
<td>3.8V</td>
<td>3.8V</td>
</tr>
<tr>
<td>Capacity</td>
<td>25Wh/L</td>
<td>50Wh/L</td>
<td>100Wh/L</td>
</tr>
<tr>
<td>Energy</td>
<td>26W/hL</td>
<td>21W/hL</td>
<td>25W/hL</td>
</tr>
<tr>
<td>Cycle Test</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
</tr>
<tr>
<td>Self Discharge</td>
<td>&lt;5%</td>
<td>&lt;5%</td>
<td>&lt;5%</td>
</tr>
</tbody>
</table>

**3.8V operating voltage!**

**25Wh/L for a 2000F cell!**
Discharge Curve (2000F, Standard Type)

- Fast recharge and discharge capability

Ragone plot: excellent Energy to Power characteristics

Load life at high temperature:
- Good performance at a temperature of 60°C

Excellent Cycle Test Performance (Ultimo 2000F Standard example)

LIC cell performs even at High Temperature

Self discharge: less than 5% after 3 months
Safety Test of LIC Cells

- **Over Charge test**: Charge up to 250% of rated capacitance with 1A constant current
- **Over Discharge test**: Discharge down to 0V with 1A constant current
- **Heat test**: Heat to 55℃, cool and heat to 85℃ 2h
- **Nail test**: Vertically penetrate a nail with 2.5mm Φ through the center of the cell

No fires, no explosions

Target Markets and future development

- **Lithium Ion Capacitor (LIC) technology** has ideal characteristics for use in transport applications:
  - Very fast charging
  - Higher Energy Density than EDLC Super-capacitors
  - Higher Power Density than Lithium Ion Battery technologies
  - Very light weight
  - Small size
  - Convenient shape for efficient stacking within a vehicle

- Lithium Ion Capacitors are currently being produced in HVM at JM Energy

Current ongoing projects for buses

- Start-stop
- Trolley-bus
- Fast charge – discharge inner city bus

Conclusions

- Lithium Ion Capacitor (LIC) technology has ideal characteristics for use in transport applications:
  - Very fast charging
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http://www.jmenergy.co.jp
http://www.jsrmicro.be

Thank you!

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