Fraunhofer ISIT

Autoclavable Batteries for Medical Devices

Pouch cell design
Bottom: Hospital autoclave

The Challenge

Product designers are continually seeking to make medical devices smaller, lighter, more ergonomic and reliable. Nowadays, a wider range of medical devices can be battery operated, such as

- Bone saws, drills
- Infusion pumps
- Bone growth stimulators
- Endoscopes
- Other lightweight medical devices

Modern rechargeable batteries have a failure mechanism; a gradual rise in their internal resistance. As a result, any sudden need for power (e.g. for motor-driven devices) may lead to a drop in voltage. Secondly, sustained operation at high temperatures also results in unwanted parasitic reactions between the electrodes and the electrolyte and a break-down of the cell structure, leading to a long-term reduction in performance. Ultimately, many more devices will have to undergo a heat sterilization after use.

Lithium-thionyl chloride cells provide the widest temperature range of all (-55 °C to +125 °C) and can be specially modified to withstand temperatures as low as -80 °C to support the medical cold chain and permit around-the-clock monitoring of pharmaceuticals, transplant organs and tissue samples that are frozen or packed in dry ice. Lithium batteries are also the preferred choice for smaller or lightweight devices such defibrillators, robotic inspection systems, RFID asset tracking tags, infusion, glucose monitors, blood oxygen meters, cauterizers because they offer the highest energy density.

Lithium-based rechargeable batteries are increasingly used in medical environments, but due its limited temperature range, its applications are still only feasible for few devices. High temperate stable rechargeable batteries are so far only proven for temperatures of up to 125 °C. Their lifetime is short and its costs are high.

Fraunhofer ISIT
A range of capabilities to design your solutions

Application developed for battery cells , and battery systems for

- Lightweight and handheld medical devices
- Battery driven tag

Industry trends – Real life examples

How lithium chemistry can be ideal for certain types of applications, amongst others:

Bone growth stimulator (BGS) requiring low continuous current: BGS' use high frequency sonic pressure waves to stimulate bone growth and healing. These devices are usually strapped onto the fracture site or fitted into a cast and emit low-intensity, pulsed ultrasound. For this application, a high energy density is required as the device is worn by the patient.

Hand-held surgical drills with very high current-pulses:
Single-use hand-held bone saws were redesigned utilizing high-energy lithium batteries located within the saw's handle, eliminating the need for wiring and external battery pack. High-power batteries were chosen for this high rate application as they can deliver high current-pulses of up to 15 Amps.

Bone drill with compact form factor:
An alternative version of the handheld bone drills were created using lithium metal oxide cells with the capability to handle high current-pulses of 15 A with a 5 A continuous load. The use of the lithium metal oxide cell reduced the need for batteries by 60% enabling faster drilling speeds and increased torque for more efficient drilling cycles.

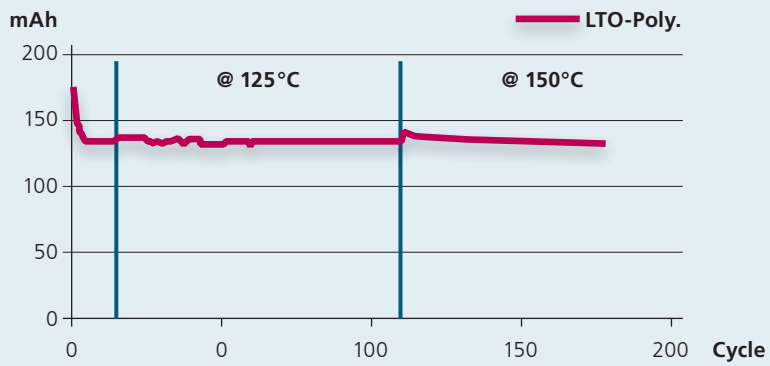
Sterilizable RFIDs:
Lithium batteries have dynamic potential for use in portable and hand-held medical devices, as well as in capsules that are swallowed and crawl through the gastrointestinal tract to perform diagnostic and surgical procedures. In addition, a new generation of medical devices is emerging that combine telematics, GPS, and RFID tracking capabilities. Previously, medical asset tracking devices had to be removed from medical equipment prior to sterilization in order to protect the battery from heatrelated damage. Nowadays, medical devices and equipment equipped withRemoval asset tags can remain online during sterilization cycles, thus enabling continuous real-time tracking and reporting.

Our Solution
ISIT has developed a high temperature, stable battery technology, which is able to be operated at temperatures above 150°C, and is therefore suitable for high temperature sterilization. The technology is based on Lithium titanate (LTO) as anode material which provides a high degree of stability in terms of battery longevity, number of deep charging cycles along with high levels of intrinsic safety. These attributes contribute toward increased operating efficiency at lower product cost, which makes this technology an ideal candidate for medical applications.

Your Benefits
- Faster sterilization process through less handling
- Compact form factor due to higher energy density
- No impact on the durability of the device
- No change in device/ application use
- Greater operating efficiencies

Electrode foil manufacturing at ISIT

Lithium Titane vs. Lithium up to 150°C



Cooperation

In collaboration for research & development projects, or in bilateral developments under NDA.

BVES GERMAN ENERGY STORAGE ASSOCIATION

Fraunhofer Institute for Silicon Technology ISIT

Fraunhoferstrasse 1
25524 Itzehoe, Germany
www.isit.fraunhofer.de

Battery Systems for Special Applications
Dr. Andreas Würsig
+49 4821 17 4336
andreas.wuersig@isit.fraunhofer.de