

Application Note: Solid State Batteries for Medtech

MedTech is evolving

The healthcare sector, or Medtech, is changing to embrace the interconnectivity of the Internet of Things for more proactive patient health management. This has created a demand for remote patient monitoring, with devices needed to monitor and report vital data to central healthcare providers. IoT Healthcare sector revenues are forecast to be around \$409.9Bn by 2022 ([Grand Review Research, 2016](#)). Improved interaction with patients through smart technology requires medical devices that:

- ▲ Improve patient experience by remote monitoring without need to visit place of care.
- ▲ Help patients to self-serve by being able to use more sophisticated devices to look after their condition better themselves.
- ▲ Improve reaction time for changes in conditions, plus the distribution and optimisation of medicines.
- ▲ Providing larger amounts of information (Big Data) to improve knowledge and treatment of conditions.

These smart devices may be external (low power wearables) or internal, implantable or ingestible devices that may be used to collect patient data or support drug delivery through 4 stages of patient care ([Deloitte, 2015](#)):

- ▲ *Prevention and well-being:*
To detect issues in advance of symptoms occurring through the deployment of wearable devices, e.g. for individuals who may be at risk of developing chronic pain.
- ▲ *Chronic pain:*
To empower individuals with diabetes or heart-problems to take better care of their condition.
- ▲ *Acute pain:*
To provide the health provider with large amounts of useful data rapidly when patients are admitted to intensive-care units.
- ▲ *Post-acute pain:*
To empower the patient to monitor the effectiveness or possible complications of acute treatment in the more relaxed and less costly home environment.

Wireless Body Area Networks (WBAN) are increasingly talked about in medical circles. The impact of WBAN on patient care and the prediction of emergencies prior to them happening is of great interest to healthcare providers globally, providing an early warning system for patients with illnesses such as heart disease, diabetes and asthma.

A WBAN is a wireless network of sensors that are either implanted in or worn by the user and which can all be networked. The increase in the range of wearable devices tracking measurements such as heart rate, blood pressure and activity levels makes this networking approach more feasible and with a lower implementation cost.



Rapid innovation in physiological sensors, low power controllers and wireless communications has enabled a new generation of sensor networks. The ability to implant very small biosensors inside the human body or on organs such as eyes can make the patient experience more comfortable & not impair normal activities, while offering constant monitoring.

The smart contact lens is a typical example of new MedTech devices which makes use of many of these technologies. It can be worn on the eye because key components are positioned around the edge of the eye to avoid interfering with the patient's vision. To scale down sufficiently requires a new level of miniaturisation for sensors, controllers and battery technology.

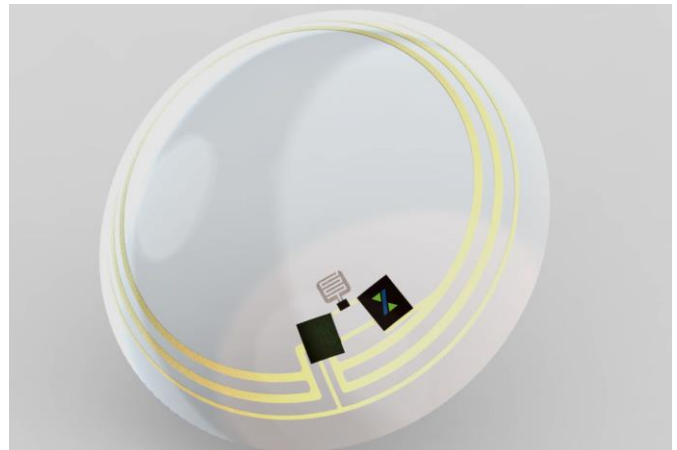


Figure 1: Contact lens illustration

Iluka's Stereax® M50 solid state battery advantages for MedTech

Iluka has designed the first solid state battery dedicated to MedTech's needs for a miniature size, long life & safe battery:

- ▲ Ultra-thin profile: Stereax® M50 batteries can be as thin as 250 µm, allowing them to be stacked in order to increase energy density.
- ▲ Footprint: 10.75 mm x 3.75 mm. Various footprint shapes including custom sizes are available.
- ▲ High energy density (50 µAh).
- ▲ Low self-discharge (nA).
- ▲ Potential to withstand autoclave temperatures.
- ▲ Potential for biocompatibility.
- ▲ No lithium metal at any stage of cycling.

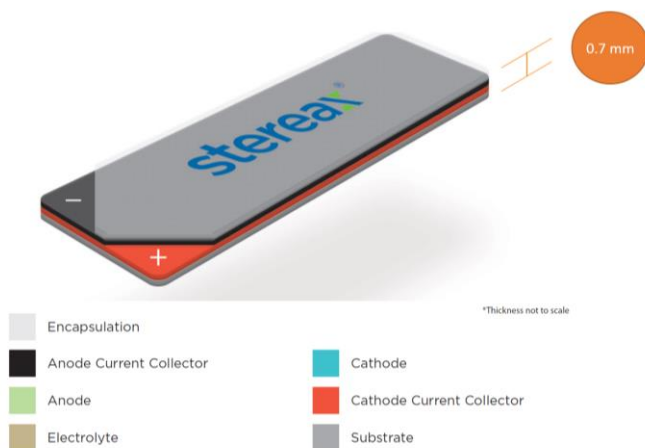


Figure 2: Graphic representation and photographic picture of M50 Stereax® solid state battery.

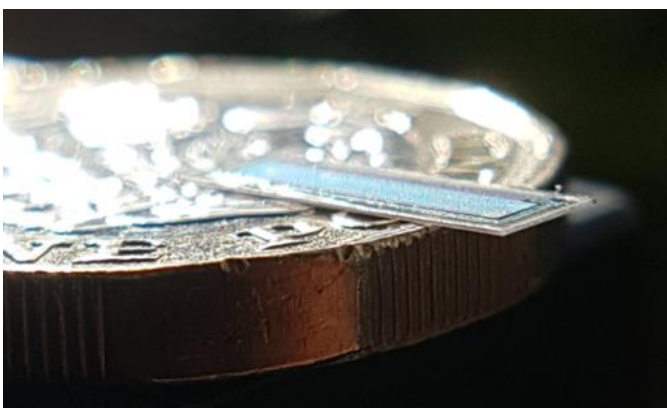


Figure 3: Photograph of M50 Stereax® solid state battery

Biocompatible Solid State Batteries

A bio-safe source to power sensors and wireless communications is vital to WBAN success. Iluka's Stereax battery technology offers a biocompatible solution that is particularly useful for powering ongoing monitors such as for glucose and blood pressure measuring. The batteries can be recharged using inductive charging probes, reducing external wiring and the risk of the battery running out of charge.

Iluka's Stereax® batteries are packaged in materials that have been tested for potential cytotoxicity effects by NAMSA, France, following the guidelines of ISO 10993-5, Biological Evaluation of Medical Devices, Part 5: Tests for in vitro Cytotoxicity. The extracted solution in Eagle Minimum Essential Medium (EME10) was added to fibroblast cells and cell viability was measured to be 100%. No cytotoxic potential was detected. This biocompatibility test evidences the potential for Stereax batteries for use in medical applications.

Typical medical device categories

- ▲ *Sensors:*
In vitro surface patches to sense the body's vital signs, skin stimulation and environment monitoring.
- ▲ *Neurostimulators:*
Stimulating vagus nerve or spinal cord to combat Parkinson's disease, Tremors, Dystonia, chronic pain.
- ▲ *Implantables:*
In vivo sensors for cardio-monitoring, pulmonary pressure and temperature.
- ▲ *Drug Delivery:*
Patches and implantables, delivering long term medication doses or specific point of efficacy drugs.
- ▲ *Ophthalmics:*
Smart contact lenses, cataract correction, tear glucose monitoring, drug delivery.



Figure 4: Neurostimulator illustration