Electro Optical Components, Inc.
5464 Skylane Boulevard, Suite D, Santa Rosa, CA 95403
Toll Free: 855-EOC-6300
www.eoc-inc.com | info@eoc-inc.com

Click to go to Product Selector

Heat flux sensors for battery monitoring

greenTEG downsizes battery calorimetry
for battery monitoring in any application

Zurich, September 2017

greenTEG

greenTEG results: comparable to a $150K Calorimeter

A gSkin heatflux sensor is:

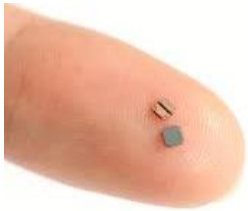
- 100 Million times smaller
- Fraction of the cost

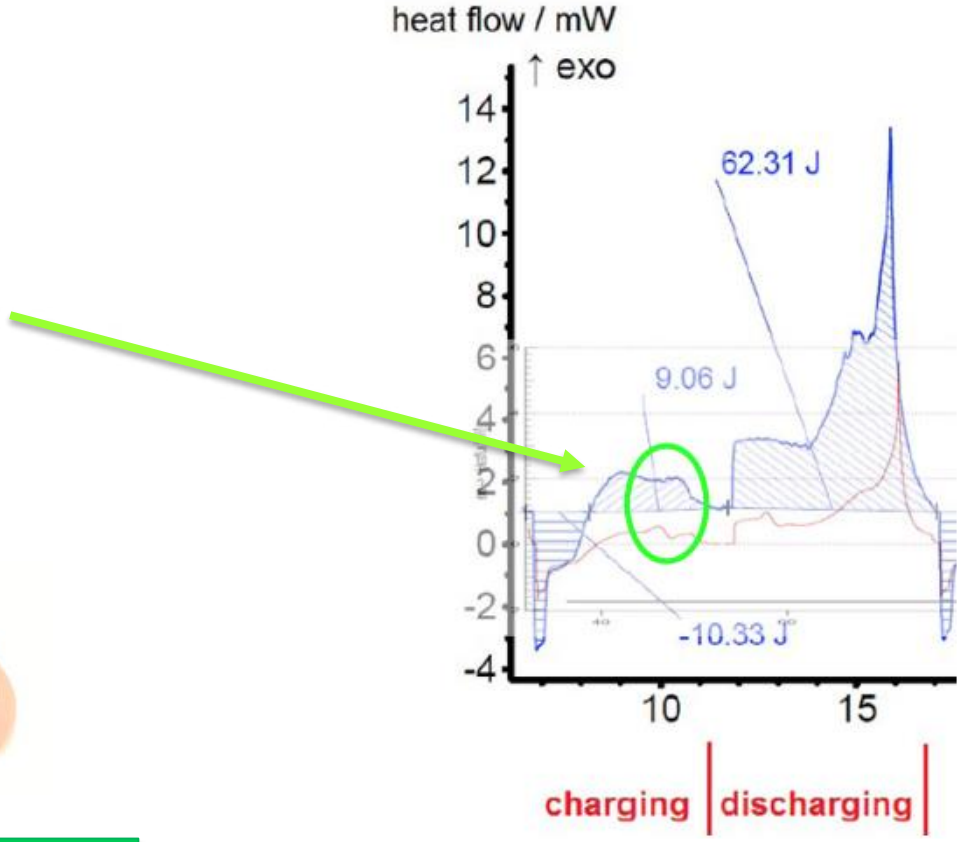
greenTEG HFS has:

- Improved feature resolution
- Lower noise level
- No offset

Netzsch MMC27V

greenTEG





greenTEG enables battery calorimetry in the real application

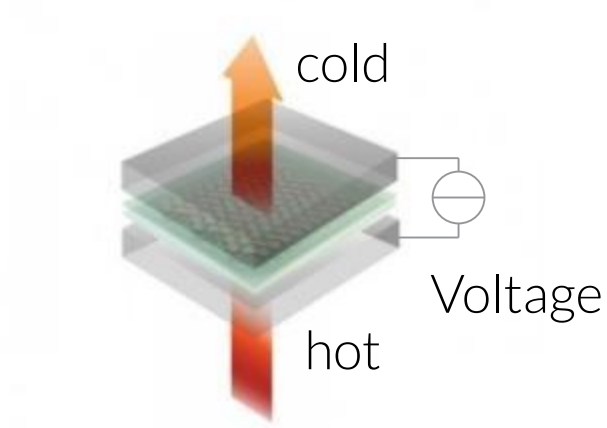
Battery calorimetry on a 45mA coin cell , cycling speed: 0.5C;
Red: greenTEG sensor
Blue: Netzsch MMC27V;
Results from EMPA[1]

[1]Swiss federal institute of material science and technology

greenTEG – the Seebeck effect explained

greenTEG fabricates thermoelectric sensors which convert heat into a voltage

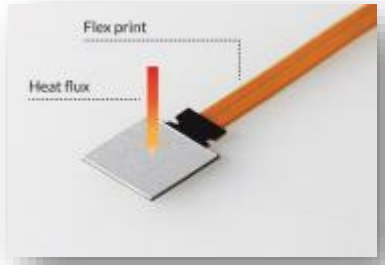
Heat flux sensor



Principle

Heat

Voltage

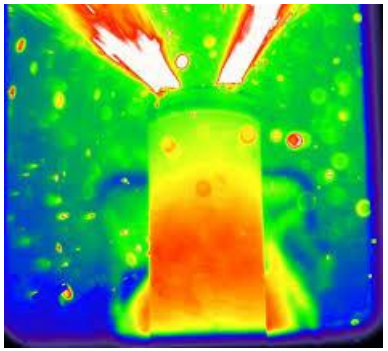


Device

greenTEG

We see many potential applications, such as thermal runaway prevention

Thermal runaway prevention



Thermal management

Status control (SOC, SOH, SOF)

Battery quality control

Deep dive: Prevent thermal runaway

Problem:

- Inner temperature of the battery should not exceed 60° C
- Inner temperature of the battery can not be monitored with surface temperature sensors

Solution:

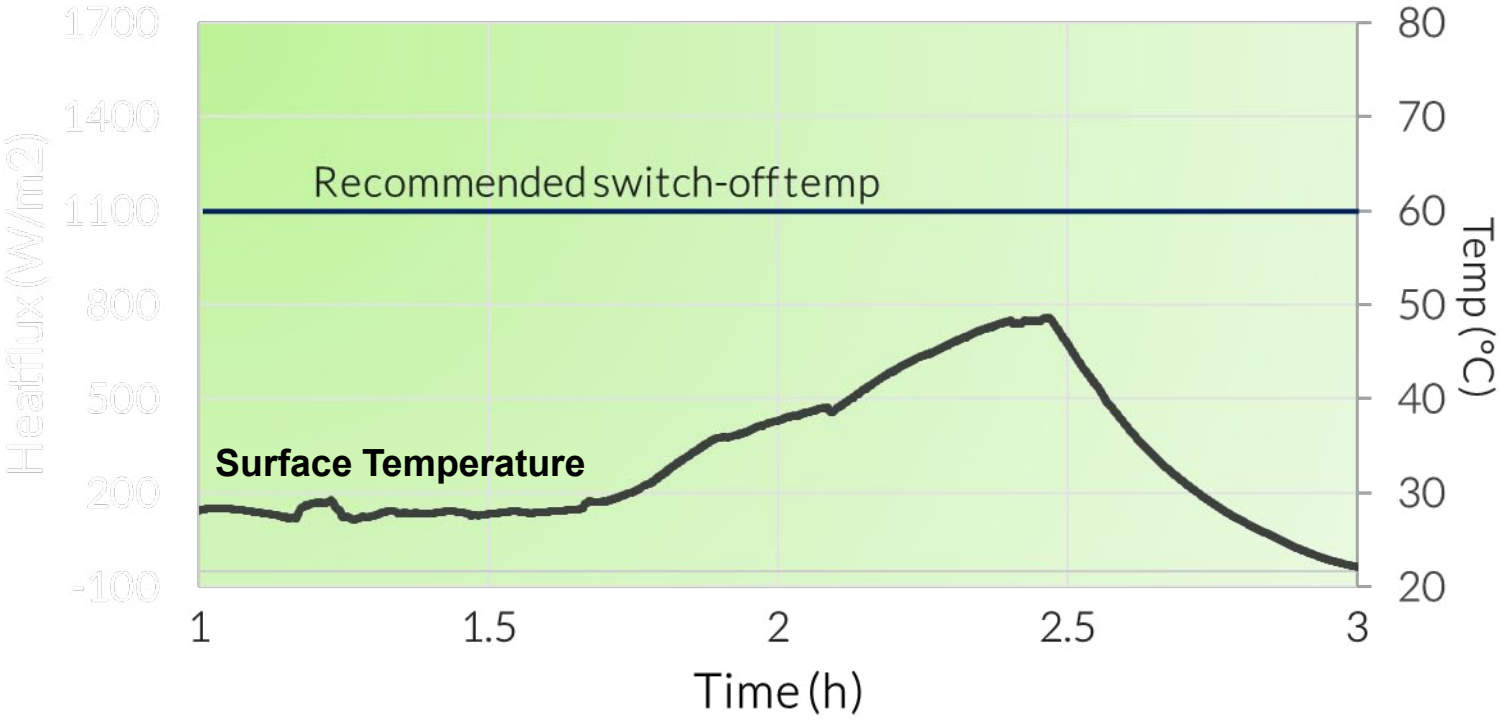
Calculate the inner temperature by combing heat flux sensor signal with surface temperature sensor signal

$$T_{inside} = T_{surface} + Q^*R$$

R = Thermal resistance
Q= Heatflux

greenTEG

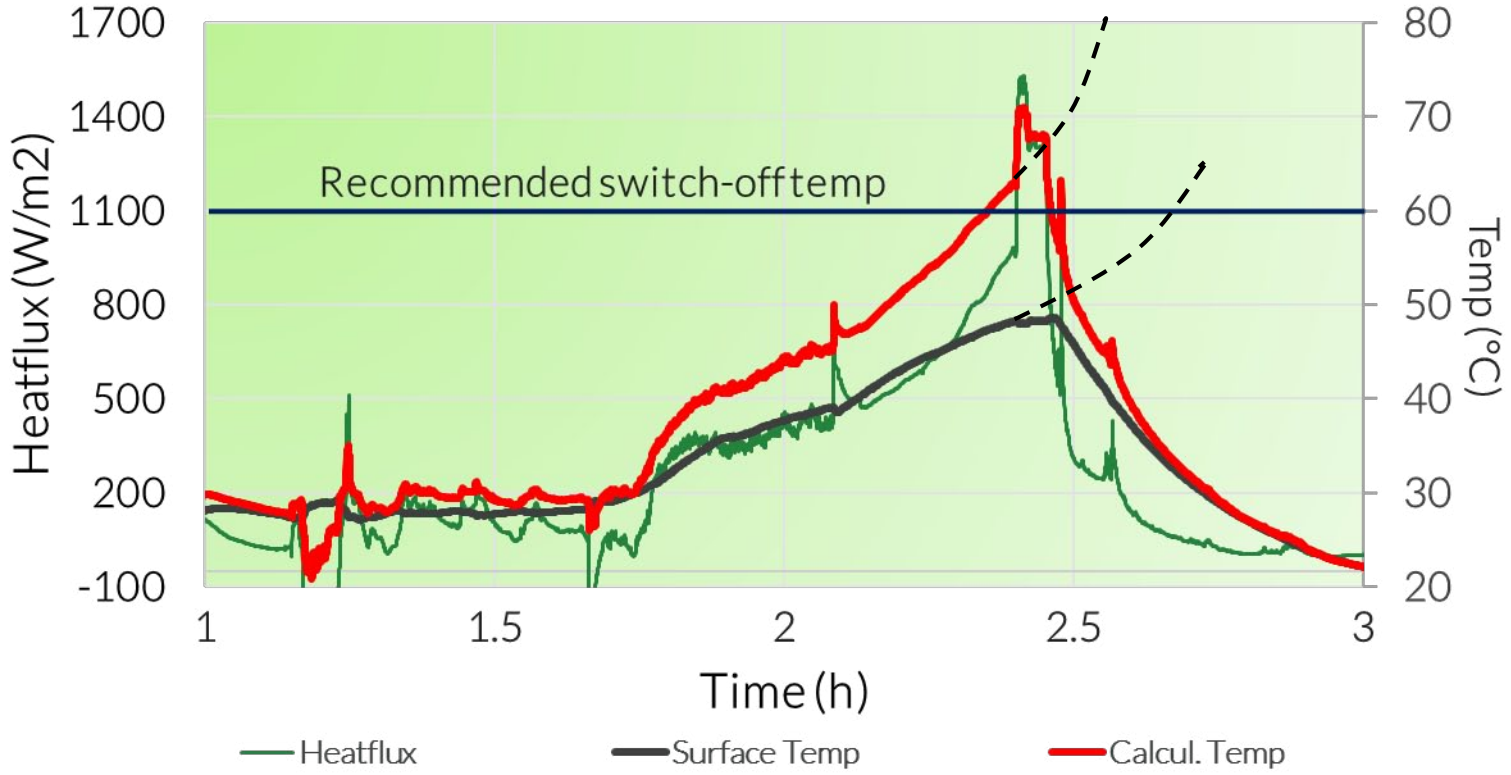
We have generated new insights: To know what's going on inside the battery / battery-pack



Surface temperature only measures 48°C→ Everything ok!?

greenTEG

Our enhanced calculation using heatflux data provides new insights inside the battery



The high Heat flux in combination with the high surface temperature reveals a critical inner battery temperature exceeding 60°C.

↳Without Heat flux measurement this brief temperature excursion is very difficult to detect

Deep dive: Battery status control and quality control

By thermal profiling

With the gSKIN®, phase transitions of Li-ions in the electrodes can be detected during the normal charging and discharging of the battery

The sharpness, amplitude and position of the peak is a clear indication of:

- **Quality**
- **State Of Health (SOH)**
- **Intracellular electrode dis-balancing**

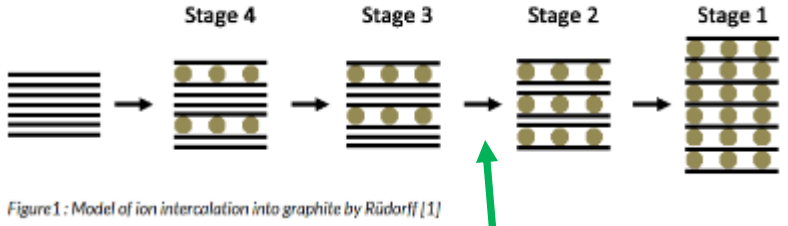
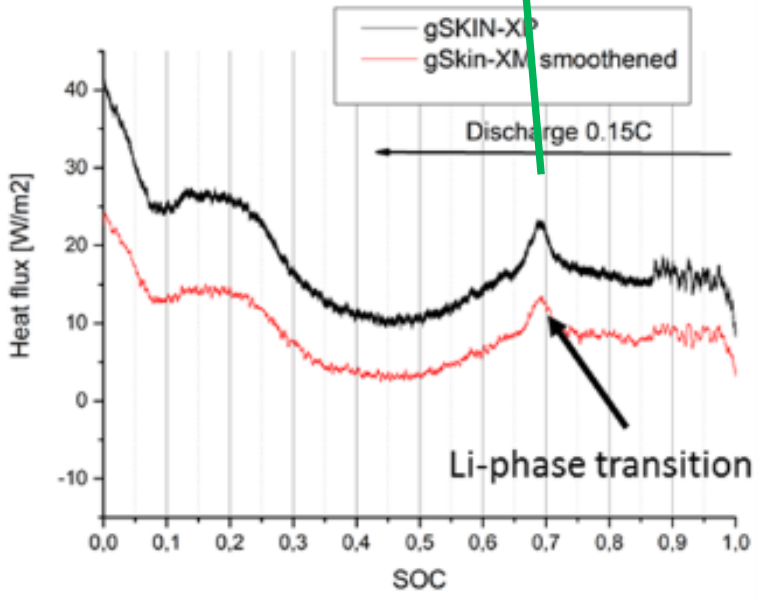
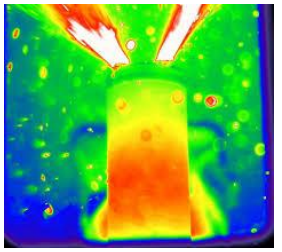


Figure 1 : Model of ion intercalation into graphite by Rüdorff [1]



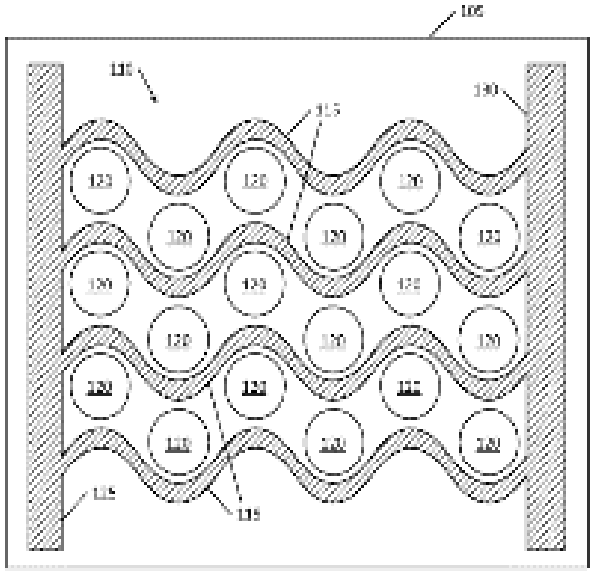
Deep dive: Battery Thermal management



Controlled cooling/heating of the batteries is known to:

- Extend Battery life
- Enable fast charging
- Avoid thermal runaway

Today's control is "only" based on temperature sensors



Reference: Patent on water cooled thermal management system from Tesla

Problem

A temperature sensor is measuring a state and not the dynamics of the system → Not the right tool for control systems (slow, overshoot)

Solution

greenTEG's heat flux sensors react immediately to temperature changes larger than 100uK resulting in:

- Much faster thermal control
- Improved thermal management

greenTEG's technology allows you to measure the thermal dissipation even when water cooled

greenTEG

We are integration experts

greenTEG provides cost efficient solutions for electrical and thermal integration of the sensors

Specifications:

- Sensor size: 2mm x 2mm x 0.4 mm
- Sensitivity: >1 uV/W/m2
- Required area: 2mm x 2mm x0.5 mm
- Standard SMD integration
- Additional packaging for thermal heat path to the battery is required

greenTEG