SENSIBAT NEWSLETTER WINTER 2022

Looking back on 2022 and forward to 2023

The objective of the SENSIBAT project is to develop two novel sensors for Li-ion batteries that measures in real-time: (i) the internal battery cell temperature and pressure (e.g. mechanical strain, gas evolution), and (ii) conductivity and impedance (separately for the anode, cathode and electrolyte).

After the completion of the first two years of the project, both sensors have been developed. In the case of the cell's internal temperature and pressure sensor, it has been demonstrated that its integration does not affect the electrochemical behaviour of 1Ah cells.

In the following months, SENSIBAT will focus on the development of a module made up of six 5Ah cells with the integrated internal temperature and pressure sensor which will be connected in series together with its BMS and junction box.

Finally, the data and insights from these new sensing technologies will be used for the development of improved state estimator functions based on an improved understanding of how, where and when degradation and failure mechanisms occur. These functions will be included in the BMS.

The SENSIBAT project is also active in disseminating the progress made, by participating in international conferences, collaborating with the BATTERY 2030+ group and organising teaching courses such as the Zeroing Course.

Wishing everyone a Merry Christmas and a good start for 2023!
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Iñigo Gandiaga Ondaro (IKE), Coordinator SENSIBAT

Update on adaptation of temperature and pressuresensors for incorporation into battery cells

One of the main SENSIBAT goals is the development of sensor units for measuring the pressure and temperature distribution inside a Li-Ion pouch cell. The development process for these sensor units was divided into two phases: First, the development of sensor matrices with 3x4 measuring points for a 1 Ah pouch cell configuration and second, the development of 5x7 measuring matrices for a 5-Ah pouch cell configuration. Particular attention was paid to the encapsulation and protection of the sensitive metallic structures of the sensors against the aggressive environment within the cell, mainly caused by the electrolyte, while ensuring a tight sealing of the assembled pouch cells to avoid leakages, especially at the sensor feedthrough area.

After the completion of the production of the first 5 Ah pouch cells with integrated sensor units, the effect of the integrated SENSIBAT sensor on the performance of the Li-ion cell was evaluated, e.g., by tracking possible side reactions of the materials used for sensor encapsulation. For this, electrochemical tests were conducted and the potential-, capacity-, as well as calculated charge and discharge resistance values were used for the electrical performance evaluation.

No negative influence of the sensor implementation on the electrochemical performance of the cells was detected. The relative discharge capacity deviation of the cells with and without sensor matrices is below 1% after the performance test and therefore not significant.

Subsequent tests with tailored data read-out circuits will be conducted to gather temperature and pressure data. The interpretation, as well as the correlation of these results and electrochemical data will be used for the state estimation algorithm development and for the final demonstrator battery module design.

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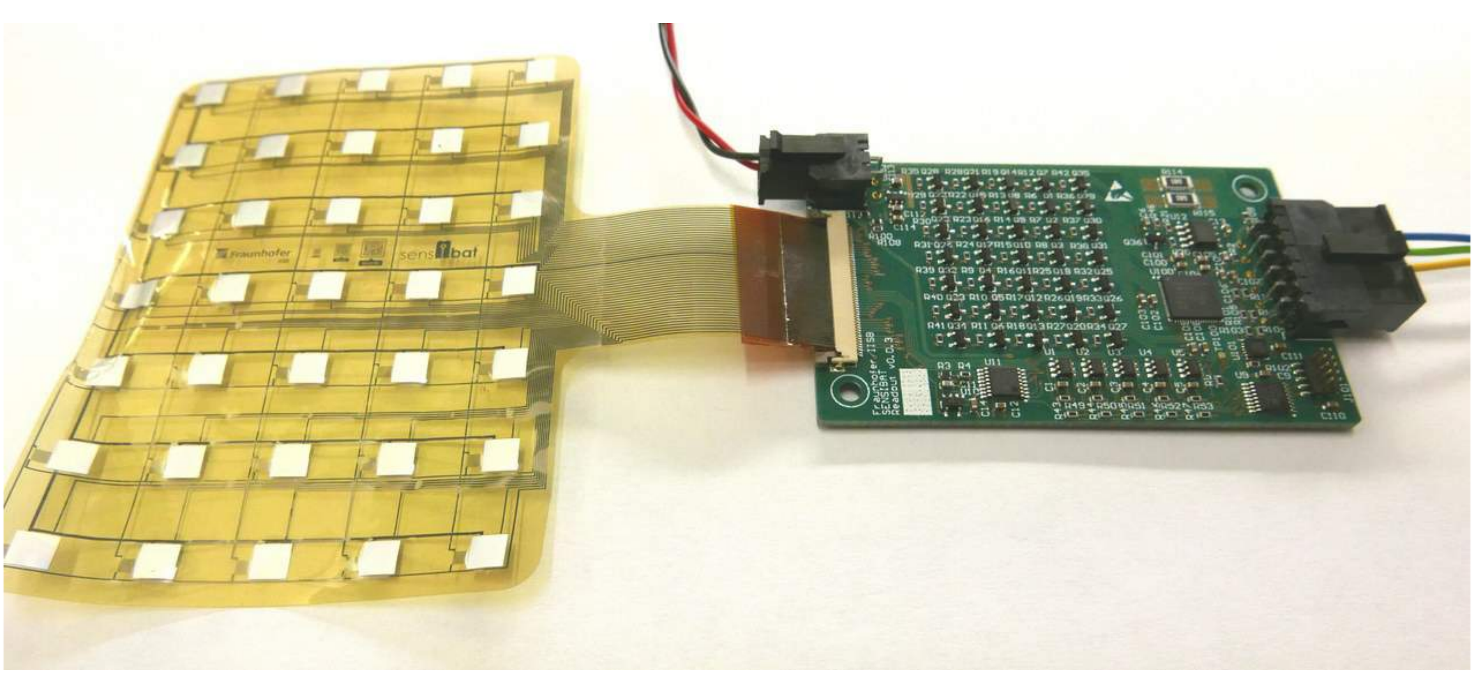
Update on the 5x7 pressure and temperature sensor matrices

The temperature sensors are based on a resistive principle and are read out using a voltage divider in combination with a voltage feed-back circuit to minimise crosstalk effects. The pressure sensors are based on a capacitive principle and the read-out circuit can address every single sensor for translating the sensor capacitance to a frequency. A microcontroller analyses the frequency and controls both the temperature and pressure sensor measurement.

The BMS will calculate the correct measurement value individually for each matrix element based on the correction factors determined during calibration, which are stored locally on the BMS. The calibration of sensors is needed to compensate for differences in the sensor characteristics resulting from slight variations in the manufacturing process. Also, the circuit needs to be calibrated to compensate for component variations and parasitic effects, e.g., caused by the board layout.

Before the 5x7 pressure and temperature sensor matrices were integrated into the 5Ah Lithium-ion cells, they were tested in the lab. The picture below shows a testing setup with the sensor matrix on the left and the read-out circuit on the right.

Currently a characterisation procedure is being developed that will be applied to all sensors and allows a fast measurement step. It is planned that this procedure can also be used when the sensor is already integrated in the cells. This allows recalibration after a certain time in use to compensate for a possible drift in the sensor characteristics. In parallel, the corresponding implementation on the BMS will be performed.



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BATTERY 2030+ Annual conference, empowering green innovation!

On September 12th we had the opportunity to finally meet our BATTERY 2030+ colleagues in person at the annual conference in Brussels. We enjoyed being able to share our progress in person and we also shared interesting presentations and had a panel discussion about sensing Li-oin batteries together with industrial partners, and the SPARTACUS and INSTABAT project coordinators.

A special thanks to the VUB (Vrije Universiteit Brussel) for hosting us at their fantastic university.

Now it is time to prepare the 3rd BATTERY 2030+ meeting on May 9-10th 2023 in Uppsala Sweden! Mark your calendars!!!

Battery 2030+ Initiative

BATTERY 2030+ is a large scale, long-term European research initiative in which SENSIBAT is included. The vision of BATTERY 2030+ is to invent the sustainable batteries of the future. This will provide European industry with disruptive technologies and a competitive edge throughout the entire battery value chain and enable Europe to reach the goals of a climate-neutral society envisaged in the European Green Deal. Visit the new website here

The SENSIBAT partners

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