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NEWSLETTER ISSUE 6

Welcome…

…. to the 6th and last issue of our NanoBat newsletter. It's always amazing how time flies. At the start of NanoBat almost three years ago, the end of the project was in the very far future, we were all excited to get started, and the Covid-19 pandemic had just hit the world. Now, that "very far future" is actually very close, the pandemic has become a side note and NanoBat is coming to an end on March 31, 2023. We were really busy in the past months to make our results known to the community: we held our final meeting & stakeholder workshop in Vienna, produced quite a few publications and launched a new subpage on our website with short clips highlighting some of our findings. Be invited one last time to dive into our world of batteries!

Final NanoBat consortium meeting & Stakeholder Workshop in Vienna

On March 1-2, 2023, the NanoBat partners had the chance to meet one more time in person before the project is coming to an end. The meeting focused on the preparation of the final Review Meeting with the EC in April but also included a lab visit to the Austrian Institute of Technology and our final Stakeholder & Advisory Board workshop.

The full report on the meeting and workshop is available on the NanoBat website.

6 short clips on innovative NanoBat solutions on optimized battery production

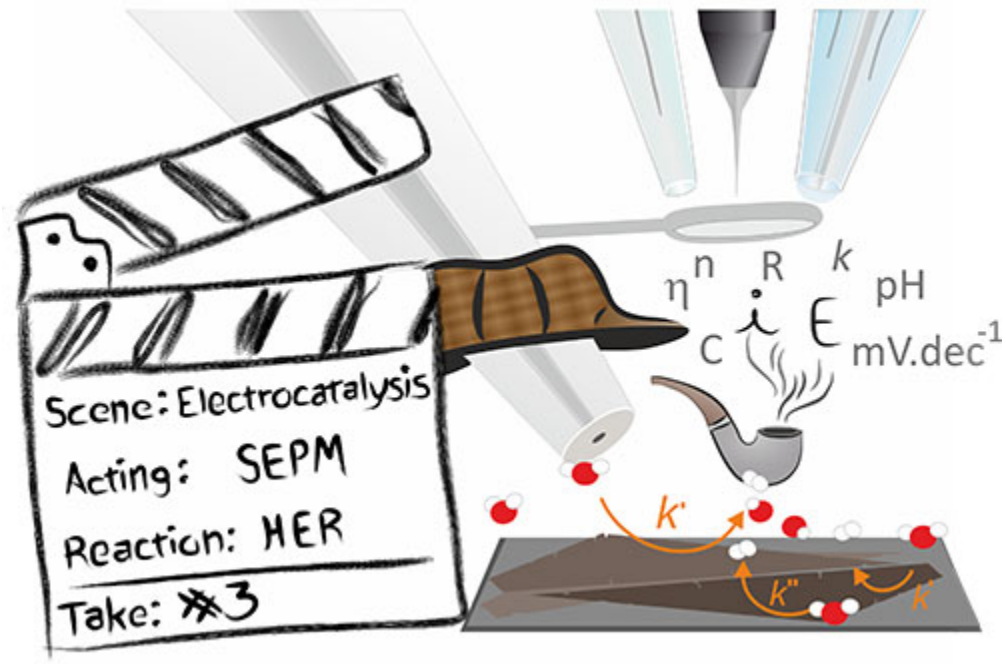
After three intense years of ground-breaking research, NanoBat ends with revolutionary solutions for battery production in Europe and beyond. The consortium has jointly developed a novel nanotechnology toolbox for quality testing of Li-on and beyond Lithium batteries with a particular focus on the nanoscale structure of the SEI (solid electrolyte interphase) layer.

You will find the clips on our new subpage!

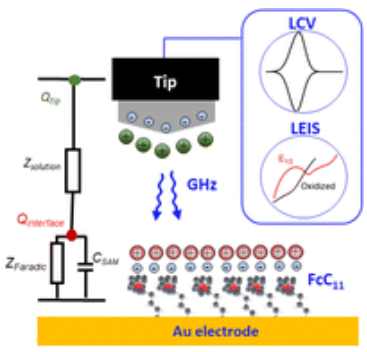
Operando Scanning Electrochemical Probe Microscopy during Electrocatalysis

Publication in Chemicals Review

This review focused in the recent progress in operando scanning electrochemical probe microscopy (SEPM) measurements during electrocatalysis. SEPM techniques can disclose the local electrochemical reactivity of interfaces in single-entity and sub-entity studies. The powerful operando SEPM measurements can correlate electrochemical activity with changes in surface properties as well as provide insight into reaction mechanisms. The capabilities of SEPMs are showcased toward
toward the reduction and evolution of O2 and H2 and electrochemical conversion of CO2. Emphasis is given to scanning electrochemical microscopy (SECM), scanning ion conductance microscopy (SICM), electrochemical scanning tunneling microscopy (EC-STM), and scanning electrochemical cell microscopy (SECCM).



The publication is availlable here.



Nanoscale electrochemical charge transfer kinetics investigated by electrochemical scanning microwave microscopy

Publication in Nanoscale Advances

We show how microwave microscopy can be used to probe local charge transfer reactions with unprecedented sensitivity, visualizing surface reactions with only a few hundred molecules involved.

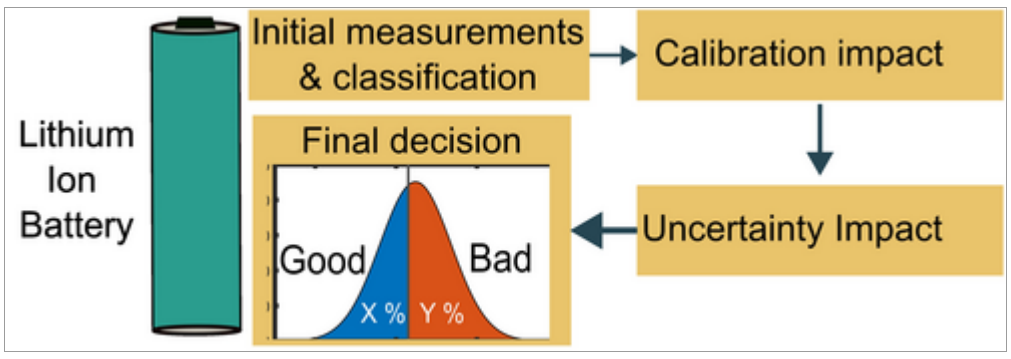
While microwaves are too fast under classical conditions to interact and sense electrochemical processes, this is different at the nanoscale, where our heterodyne microwave sensing method allows for highly sensitive local cyclic voltammetry (LCV) and local electrochemical impedance spectroscopy (LEIS).

The publication is available here.

Quantitative Cell Classification Based on Calibrated Impedance Spectroscopy and Metrological Uncertainty

Publication in Batteries and Supercaps

Electrochemical impedance spectroscopy (EIS) is widely used for battery cell testing in industrial production and R&D labs. This work addresses the use of EIS calibration and uncertainty analysis in cell classification. Five scenarios are investigated to discuss qualitatively the impact of calibration and uncertainty on classification.

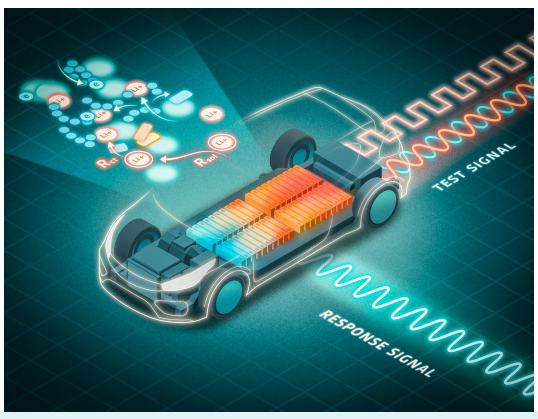


The publication is availlable here.

Calibrated Electrochemical Impedance Spectroscopy and Time-Domain Measurements of a 7 kWh Automotive Lithium-Ion Battery Module with 396 Cylindrical Cells

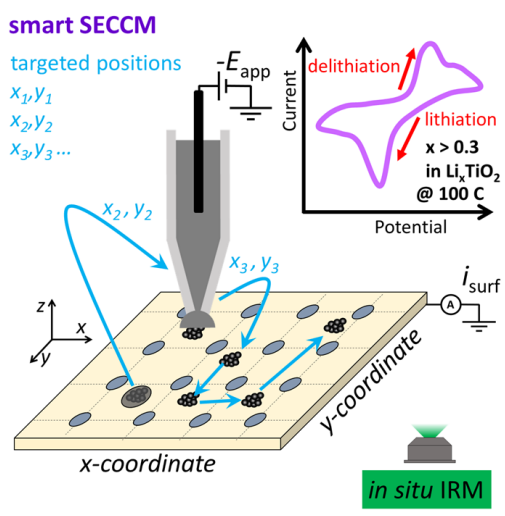
Publication in Batteries & Supercaps

A 7 kWh automotive battery module with 396 interconnected cells was tested with



electrochemical impedance spectroscopy (EIS) and time-domain pulsing over 260 charge-discharge cycles. An EIS calibration workflow was developed for low complex impedance values in a frequency range of 1 kHz to 50 mHz. Significant corrections on the resistance and the reactance were obtained from the calibration, particularly at frequencies above 100 Hz.

Find the full publication here.



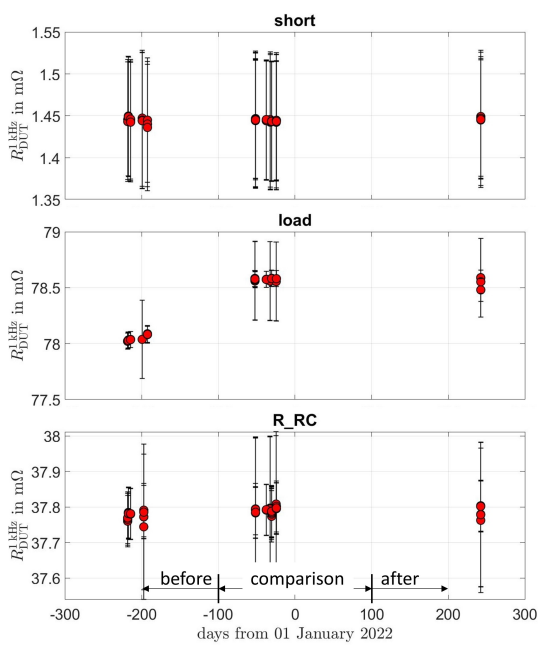
Fast Li-ion Storage and Dynamics in TiO2 Nanoparticle Clusters Probed by Smart Scanning Electrochemical Cell Microscopy

Publication in Angewandte Chemie, International Edition

Anatase TiO2 is a promising material for Li-ion (Li+) batteries with fast charging capability. However, Li+ (de)intercalation dynamics in TiO2 remain elusive and reported diffusivities span many orders of magnitude.

Here, we develop a smart protocol for scanning electrochemical cell microscopy (SECCM) with in situ optical microscopy (OM) to enable the high-throughput charge/discharge analysis of single TiO2 nanoparticle clusters.

Find the full publication here.



Measurement Uncertainty in Battery Electrochemical Impedance Spectroscopy

Publication in IEEE Transactions on Instrumentation and Measurement

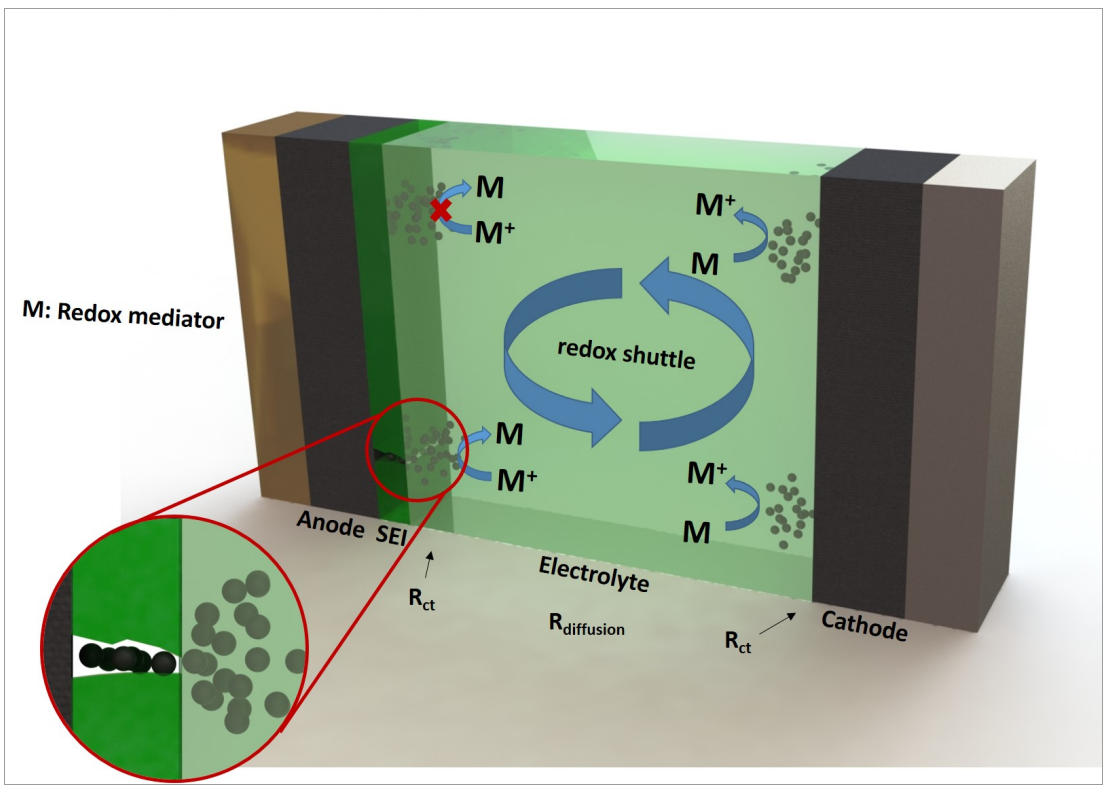
Accurate measurement of the impedance over a broad frequency spectrum is of high relevance in battery tests, also requiring specific calibration methods and evaluation of error bounds. Here, we report for the first time a comprehensive uncertainty analysis of calibrated EIS for batteries. We aim to identify two uncertainty sources, the fixture repeatability and measurement noise, and evaluate their effect on the measured impedances.

Find the full publication here.

New Technique for Probing the Protecting Character of the Solid Electrolyte Interphase as a Critical but Elusive Property for Pursuing Long Cycle Life Lithium-Ion Batteriesy

Publication in ACS Applied Materials & Interfaces

We propose a new and cost-effective method to analyze the quality of the SEI on the negative electrode of Li-ion batteries (LIBs). By adding a redox-mediator in the electrolyte and applying a few charge and discharge cycles, the presence of the mediator enables a shuttle effect that decreases coulombic efficiencies, enhancing the sensitivity to the SEI's insulating nature. These findings can accurately predict the cyclic behavior of LIBs under extended operating conditions, which is relevant for understanding future industrial needs in battery R&D.



Find the full publication here!

Upcoming Events

MMA 2023 – 12th International Conference on Microwave Materials and their Applications, Sept. 25-28, 2023, Mainz, Germany

Although NanoBat will have ended by this time QWED plans to present NanoBat results not only in the invited talk by Malgorzata Celuch. Eventually, an exhibition booth is planned to demonstrate the 2D scanner developed within NanoBat.

More information is avaialble on the conference website!

And now it's time to say good-bye. We are truly happy that you joined us on our exciting journey with NanoBat and hope that you enjoyed it as much as we did..

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The NanoBat project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 861962.

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