CUSTOMCELLS AT A GLANCE
Electrodes, lithium-ion pouch cells & services from CUSTOMCELLS
CUSTOMCELLS acts customized to your needs. We have the right experts to help you in all aspects of technical consulting and electrode, cell, energy storage prototyping. We support you in the technology ramp-up from laboratory to production scale.

POUCH CELLS ARE OUR PASSION!

Our cells are flexible in design, form and chemistry. CUSTOMCELLS accompanies the way of development and production from material level to battery system.

CUSTOMCELLS AT A GLANCE

- 40 employees
- 4 customers supported to set up own facility
- 18 years technology background
- 450 companies are customers base
- >1.100 projects team experience
- 14 electrode technologies industrialized
CONSULTING AND SERVICE

PORTFOLIO

CHEMICAL SERVICES

With you we improve and develop an individual recipe also based on your raw materials. We conduct objective benchmarking studies, understand your development challenges and therefore accelerate your market entry.

ENGINEERING SERVICES

We design, prototype and manufacture battery systems with and without cooling systems based on thermodynamic simulations. For BMS (hard- and software) systems we can rely on our partner network.**

CONSULTING SERVICES

CUSTOMCELLS’ experts create market analysis and feasibility studies as well as material consulting and technology benchmarking. For pricing and competitor analysis we are in a close partnership with P3 group.

SEMINARS & PRACTICAL TRAININGS

In our seminars we follow your demands. We offer different target groups and individual expert level workshops. Our main focus is concentrated on our production insight.

We also offer:

- Performance, environmental and aging tests
- Post-mortem analysis
- Customized electrolyte development and production*

We also offer:

- Process and factory simulation
- Technical re-construction, critical design review
- General CAD construction, FEM, renderings
- Module and pack design and construction

We also offer:

- Technology licensing
- Supply chain optimization
- Expert in-house consulting
- Process / yield optimization
- Technology & process consulting***

* E-Lyte Innovations GmbH, ** Fraunhofer ISIT / Reese + Thies Industrielektronik GmbH, *** P3 group
The lithium-ion battery market is growing with growth rates of more than 20% p.a.. Especially for the further increase of the energy density and intrinsic safety at cell level as well as the introduction of new cell chemistries, new materials are mandatory. Our battery experts support you objectively in important questions such as:

- What are the current market requirements and needs?
- Does the material suit the sophisticated lithium-ion battery market?
- Does the material offer unique selling points to provide a competitive advantage compared to the state-of-the-art materials?
- What are the prospects of returns for the market entry?

**BENCHMARKING - FROM LAB SCALE TO PILOT PRODUCTION**

We can benchmark your materials at every stage of the production process and guide you to a successful market entry.

- Material characterization
- Slurry recipe
- Electrode coating of customers’ materials
PRODUCTION INSIGHTS WORKSHOP

KNOWLEDGE TRANSFER & LITHIUM-ION CELL MANUFACTURING

CUSTOMER FOCUSED WORKSHOP

In this training you receive all important informations about manufacturing lithium-ion cells and it will give you a deep understanding of the battery market. Experts in the field of cell prototyping and design will give a wide view on specifications and follow your demands. Your questions will be answered in our workshops.

CONTENTS

In addition to the theoretical scope in lithium-ion technology, the construction of cells is carried out in practical courses (depending on the workshop level). You will learn how the individual components of a cell are produced, their behaviour and properties and learn first-hand the production steps from raw materials to the finished cells.

INFORMATION ABOUT CUSTOMIZING LITHIUM-ION CELLS

- Battery market overview
- All theoretical aspects from raw material to lithium-ion cell
- Deep understanding of cell production processes
- Customer focused workshop

PRACTICAL BATTERY TRAINING

- Electrode coating
- Pouch cell stacking and cell assembly
- Slurry mixing and recipe creation
- Automated manufacturing line

> BASIC
Basic knowledge-transfer especially tailored for the later discussion on cell specifications.

> MEDIUM
Get an insight in the state-of-the-art production of commercial lithium-ion pouch cells.

> ADVANCED
Get a detailed insight in the state-of-the-art production process of commercial lithium-ion pouch cells.

> EXPERT
Customer specific theory and detailed insight in the development and production process of tailored lithium-ion pouch cells.
LEADING MANUFACTURER
OF CUSTOM-BUILT CELLS

- About 250 raw materials on stock for short reaction time
- 14 electrode technologies industrialized
- Worldwide supplier network for state-of-the-art raw materials
- Superior grades in purity and excellent quality on electrodes
- CUSTOMCELLS’ expertise is the in-depth understanding of raw materials characteristics

We are a trusted partner to our customers in selecting the best materials for their requirements.

RAW MATERIAL

<table>
<thead>
<tr>
<th>Cathodes</th>
<th>Anodes</th>
<th>Inactive materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMC 111 / 532 / 622 / 811, LFP, NCA, LFMP, LMNO, LCO, LMO</td>
<td>C, LTO, SiC</td>
<td>Substrates, conductive, agents, binders, additives</td>
</tr>
</tbody>
</table>
CUSTOMCELLS produces various electrodes with superior performance. We are also recognized worldwide as a trustable partner in contract coating and electrode supply based on our or your own chemistries and recipes. Our production plant offers numerous mixing machines from 1 liter up to 200 liters, supreme coating equipment from batch coating up to reel-to-reel processes for serial production. Area capacities and weights are adjustable. The electrode foils are in a wide portfolio of active materials. They are adjustable in calendering grades, coating width and slitting. Our portfolio is also based on modern water based solvents. Our coating facility offers various coating heads as slot die or doctor blade.

Mathis and CUSTOMCELLS have worked together for many years allowing CUSTOMCELLS to provide the best coating and drying technology and therefore flexible design for its battery design.

Clemens Disch
Werner Mathis AG, Coating and Textile Machinery

- Coating width up to 450 mm
- Throughput 20 MWh/p.a.
- Different dispersers
  1 / 20 / 50 / 200 liter

SLURRY
Individual composition

COATING
Electrode loading
Electrode density
HIGH QUALITY ELECTRODE SHEETS SAVE YOU UP TO 49% R&D COST

The electrode sheet product line provides all modern active materials and fulfil the gap between the half cell and the full cell. High quality electrodes and consistent electrode compositions are mandatory to be successful in material cell development.

- The wide tab area allows even the fast set up of multilayer cells
- Reduces equipment costs
- Less machine hours, faster results

READY-TO-USE ELECTRODE COINS SAVE YOUR TIME AND EFFORT

CUSTOMCELLS’ electrode coins are optimized for EL-CELL electrochemical test equipment. The electrode coins allow professional researchers a fast and precise workflow at low costs. Electrode coins are provided ready-to-use in inert atmosphere packaging. This will save you effort, time and cost.

- Fully standardized in 13 & 18 mm diameter
- Prepared and optimized for half and full cell testing
- Simple glovebox handling due to single packaging
- Pre-dried and sealed in inert gas atmosphere

CUTTING & CALENDERING
Cell design
Mechanical punching & laser cutting
Flexible in calendering grades
INDIVIDUALIZED MULTI-OPTION CELLS BY CUSTOMCELLS

While standard cells only feature standard performance, CUSTOMCELLS offers individualized multi-option cells suiting exactly to your application. Electrodes based on future materials, high safety configurations and unrivaled performance make these cells perfect to suit even the roughest applications.

CHOOSE AMONG THESE POSSIBLE SPECIFICATIONS

- **Capacity**
  - up to 350 Ah

- **High power rates**
  - up to 50 C

- **Usage of future materials**
  - with 250 different raw materials on stock

- **Ultra-high energy densities**
  - up to 300 Wh/kg or 850 Wh/L

- **Low internal resistance**
  - and fast charging ability

- **Highly safe technologies**

- **Extended operating temperature range**

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**CELL ASSEMBLY**
- Pouch forming
- Tab welding
- Packaging and filling

**FORMATION & TESTING**
- Adapted formation for each cell chemistry
- Individual testing protocols
- Rate capability, cycle life, impedance, SOC
- Measurement of evolving heat during cycling
CUSTOMIZED BATTERY SYSTEM PROTOTYPES AND LOW VOLUME SERIES

- Innovative cooling concepts and high safety battery systems
- Lightweight construction and integrated design
- Customer specific adaption of battery system to space requirements and operational conditions
- Strategic partners for complex BMS development, pack construction and charging infrastructure
- Whole optimization beginning from raw materials to the final battery system

COMPETENCE IN CUSTOMIZED BATTERY SYSTEMS

- Subsea pressure neutral battery systems
- Aerospace battery systems
- AUV and drone battery systems
- UAV and ROV battery systems
- High performance EV battery systems
- Medical battery systems
# PORTFOLIO OF ELECTRODES

<table>
<thead>
<tr>
<th>Active material</th>
<th>Specific capacity</th>
<th>Safety</th>
<th>Special features</th>
</tr>
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<tbody>
<tr>
<td>Lithium-Manganese-Oxide LMO</td>
<td>110 mAh/g</td>
<td></td>
<td>High operation potential, good rate capability</td>
</tr>
<tr>
<td>Lithium-Nickel-Manganese-Oxide LNMO</td>
<td>110 mAh/g</td>
<td></td>
<td>High voltage spinell (5V), low stability, special electrolyte required</td>
</tr>
<tr>
<td>Lithium-Iron-Phosphate LFP</td>
<td>150 mAh/g</td>
<td></td>
<td>Nontoxic, but low operation potential</td>
</tr>
<tr>
<td>Lithium-Iron-Manganese-Phosphate LFMP</td>
<td>150 mAh/g</td>
<td></td>
<td>NEW, higher potential, than LFP, cobalt free</td>
</tr>
<tr>
<td>Lithium-Nickel-Manganese-Cobalt-Oxide NMC-111</td>
<td>150 mAh/g</td>
<td></td>
<td>First generation NMC material, medium capacity</td>
</tr>
<tr>
<td>Lithium-Nickel-Manganese-Cobalt-Oxide NMC-532</td>
<td>155 mAh/g</td>
<td></td>
<td>Higher capacity and slightly reduced safety compared to NMC-111</td>
</tr>
<tr>
<td>Lithium-Nickel-Manganese-Cobalt-Oxide NMC-622</td>
<td>160 mAh/g</td>
<td></td>
<td>State-of-the-art NMC material, reduced cobalt content</td>
</tr>
<tr>
<td>Lithium-Cobalt-Oxide LCO</td>
<td>160 mAh/g</td>
<td></td>
<td>State-of-the-art material for power electronics</td>
</tr>
<tr>
<td>Lithium-Nickel-Cobalt-Aluminium-Oxide NCA</td>
<td>170 mAh/g</td>
<td></td>
<td>High energy material</td>
</tr>
<tr>
<td>Lithium-Nickel-Manganese-Cobalt-Oxide NMC-811</td>
<td>175 mAh/g</td>
<td></td>
<td>High energy, nickel rich NMC, lower stability</td>
</tr>
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<tr>
<td>Lithium-Titanium-Oxide LTO</td>
<td>150 mAh/g</td>
<td></td>
<td>Long cycle life, high rate capability</td>
</tr>
<tr>
<td>Graphite C</td>
<td>350 mAh/g</td>
<td></td>
<td>State-of-the-art material</td>
</tr>
<tr>
<td>Silicon-Graphite SiC</td>
<td>400 - 1000 mAh/g</td>
<td></td>
<td>Different silicon contents available</td>
</tr>
</tbody>
</table>
AHEAD IN CELL INNOVATION

LITHIUM-ION CELLS
BATTERY SYSTEMS
SERVICES ON CELL AND
BATTERY DEVELOPMENT
CHEMICAL AND
ENGINEERING SERVICES

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