evs 27
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Fraunhofer IKTS

Process development and optimization for Li-ion battery production

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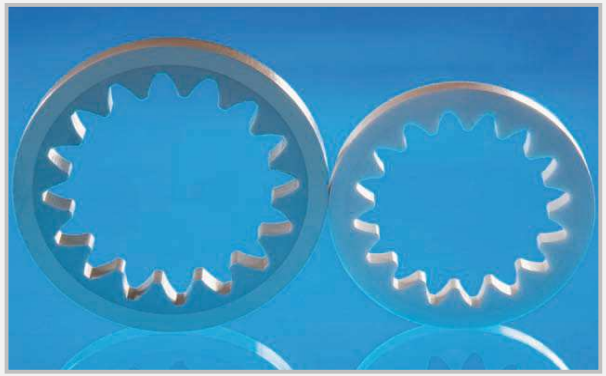
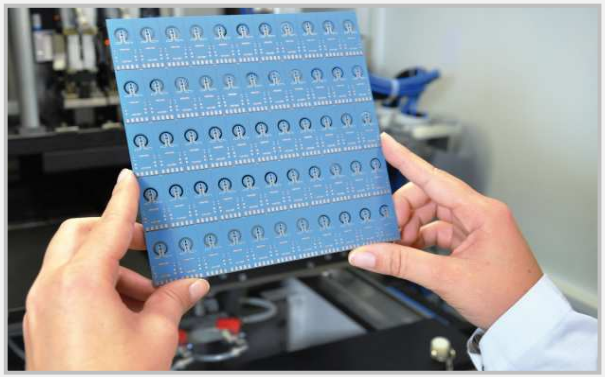
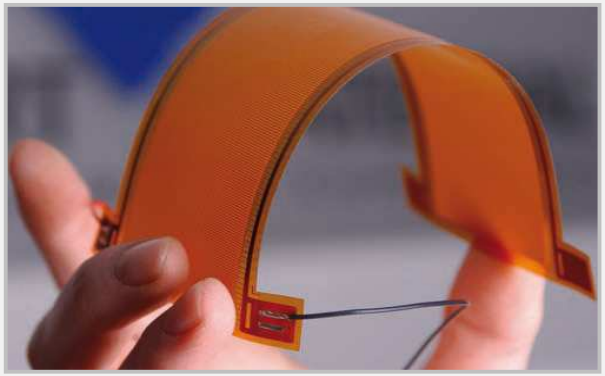
Fraunhofer IKTS in profile - Research fields

Structural ceramics



Functional ceramics





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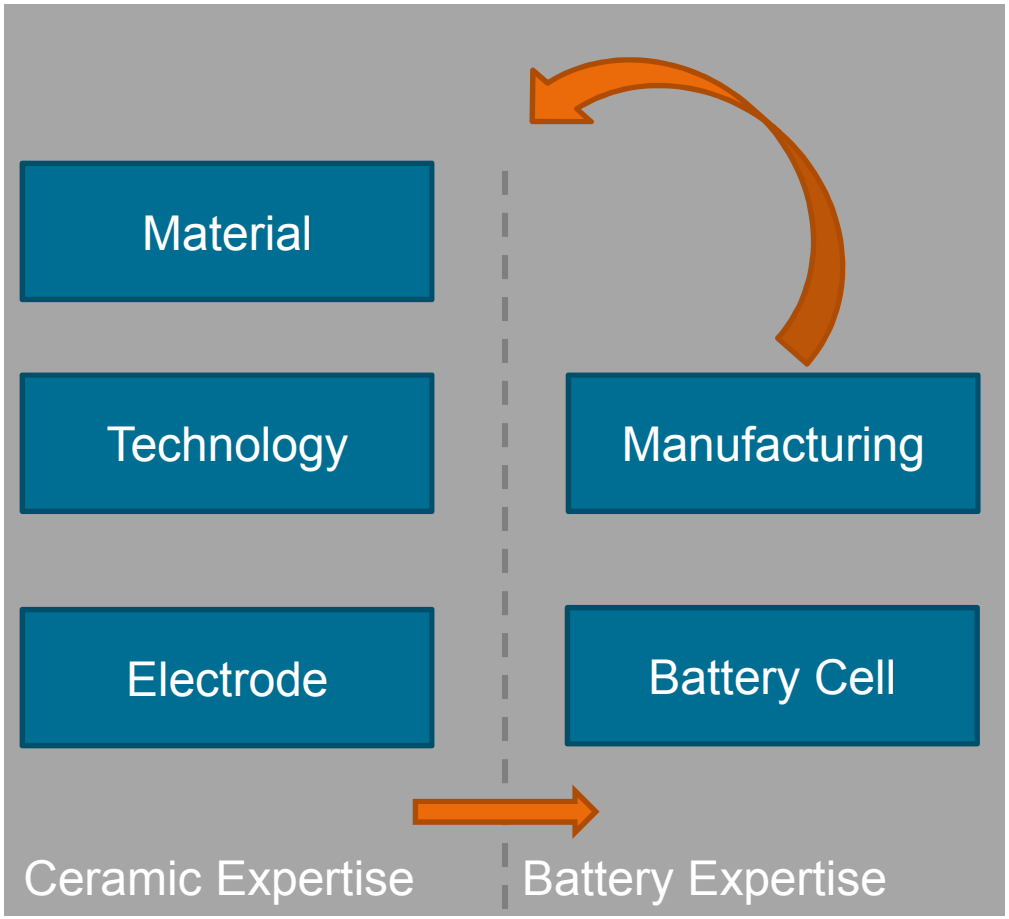
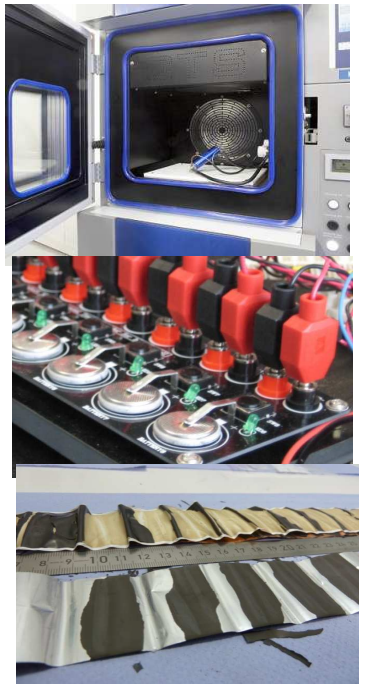
Battery research at Fraunhofer IKTS





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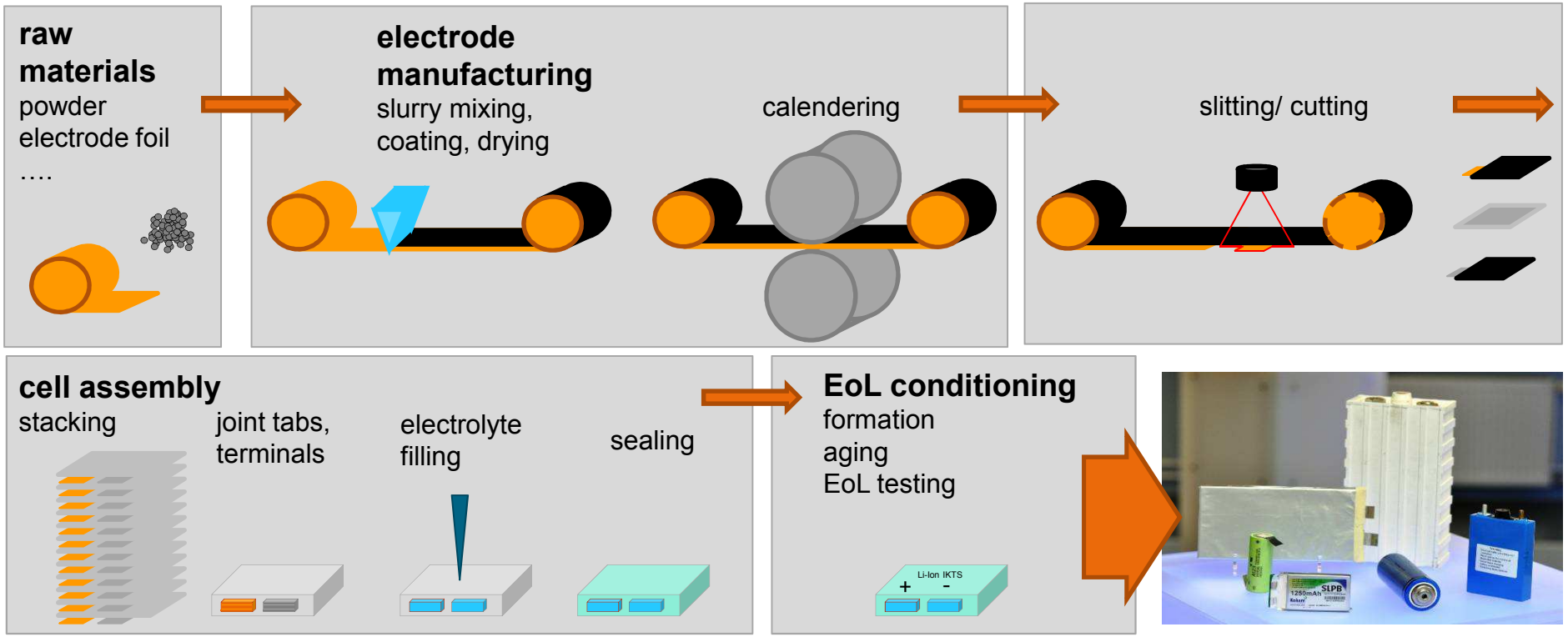

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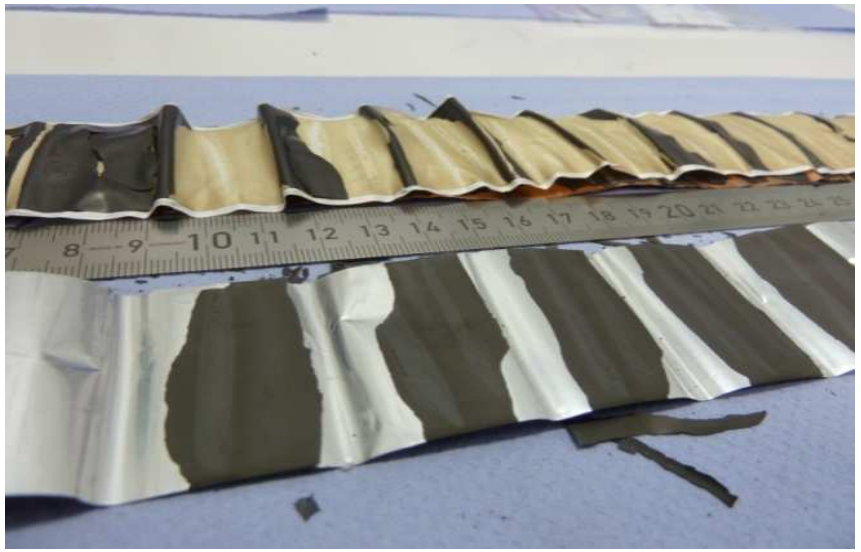
Process development and optimization for Li-ion battery production

- **Optimum battery performance** and lifetime relies on optimized battery production

- Process optimization is the main tool to reach **cost targets**



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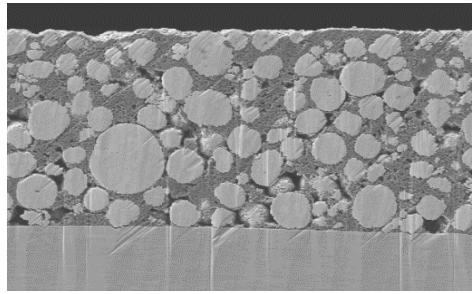
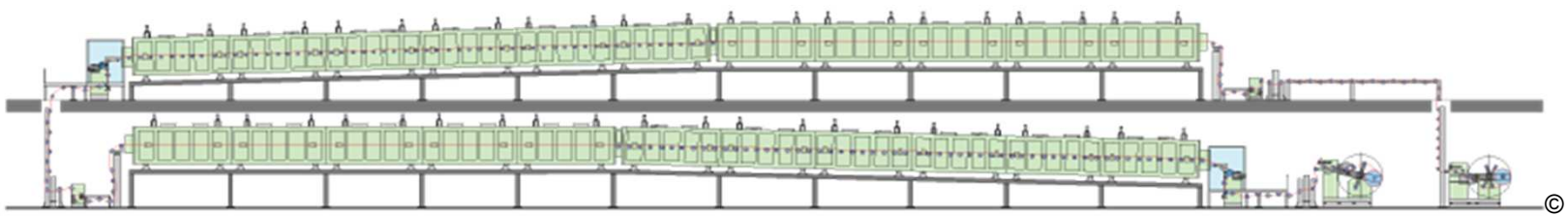
Electrode manufacturing

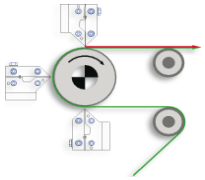
- State of the art coating technology developed for small consumer cells

- Automotive application requires
  4x lifetime
  10x cycle number
  20x larger electrode areas

→ significant higher requirements on production processes







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Process development and optimization for Li-ion battery production

- Relevance of process steps regarding battery quality

	mixing	coating	calendering	slitting	stacking/ winding	connecting electrodes/ packaging	electrolyte filling/ sealing	formation / aging	clean / dry room environment
battery performance /life time									
battery failures									

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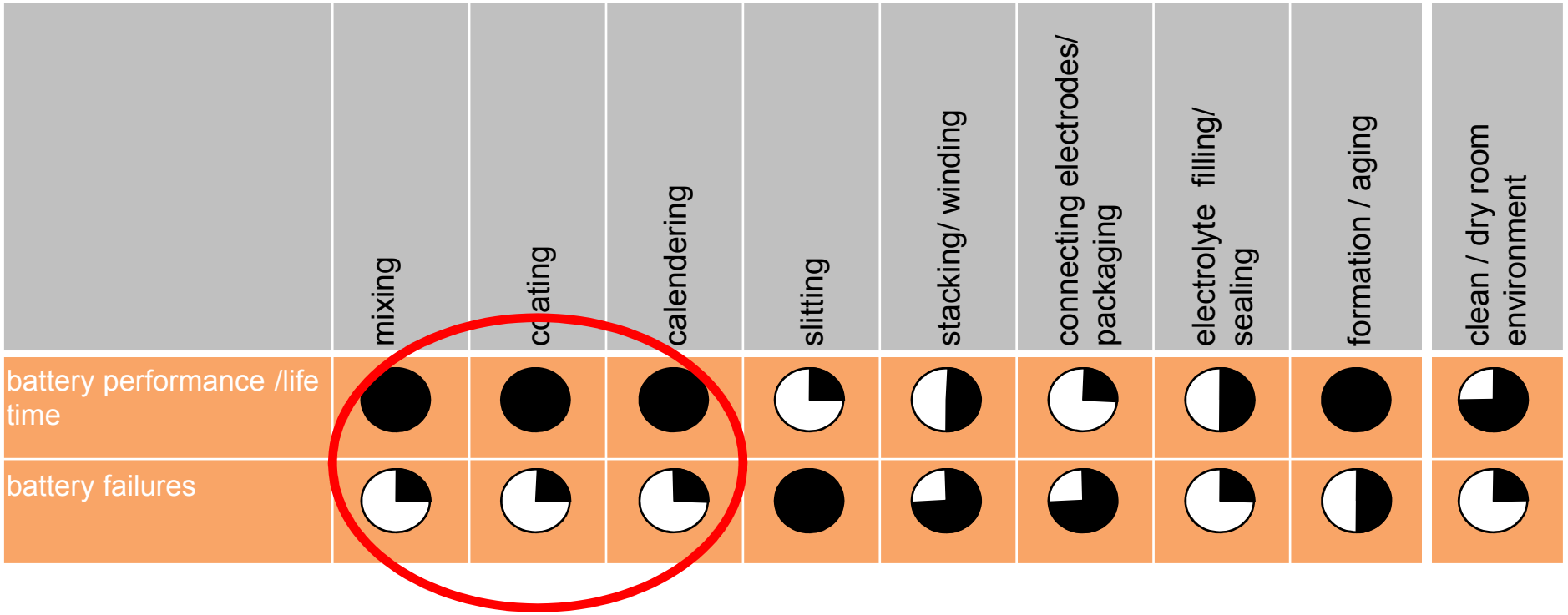
Process development and optimization for Li-ion battery production

- Relevance of process steps regarding battery quality



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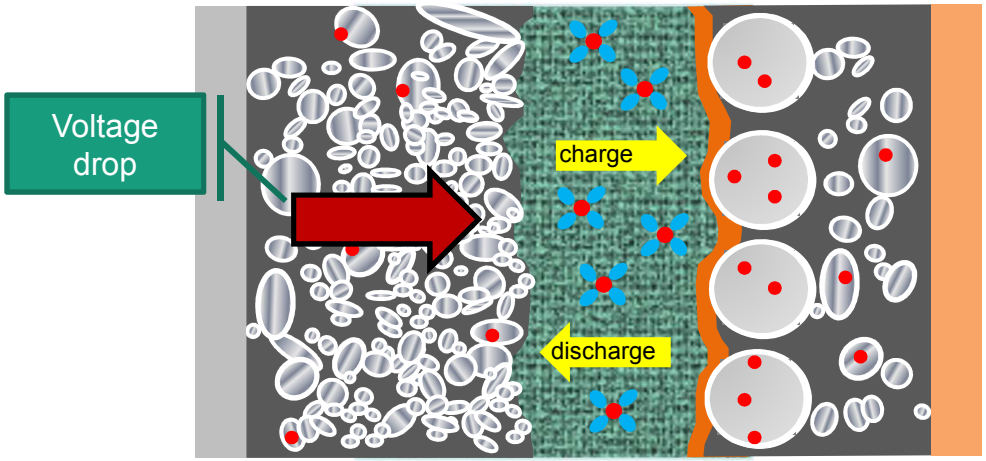
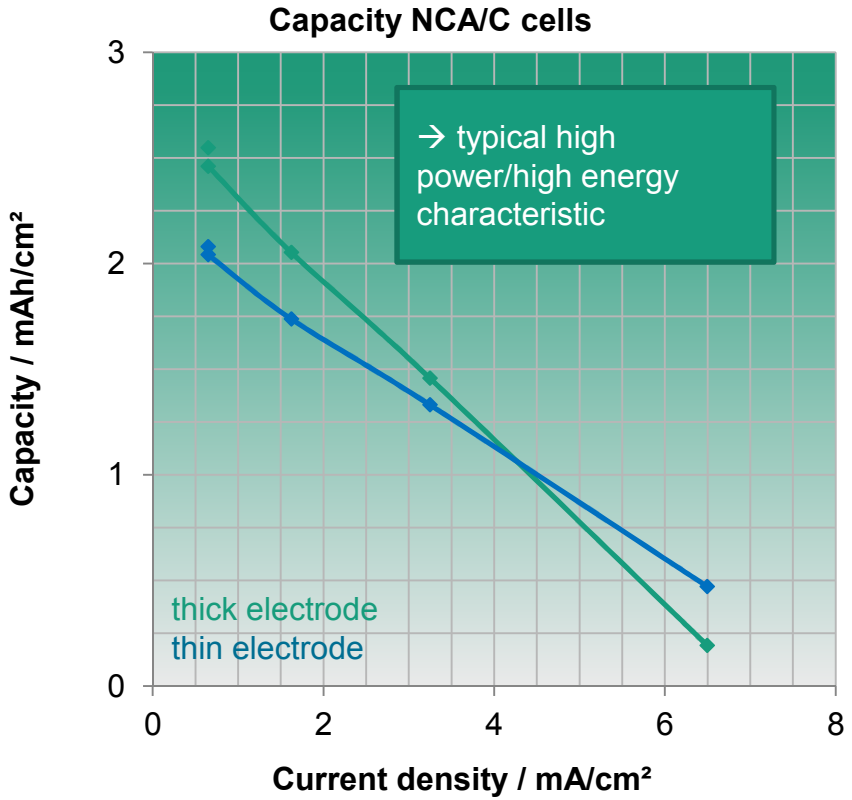
Understanding process parameters I

Electrode geometry

- Significant influence on energy and power characteristics
- Formation of electrically conductive network → crucial for thicker high ED-electrodes and high C-rates





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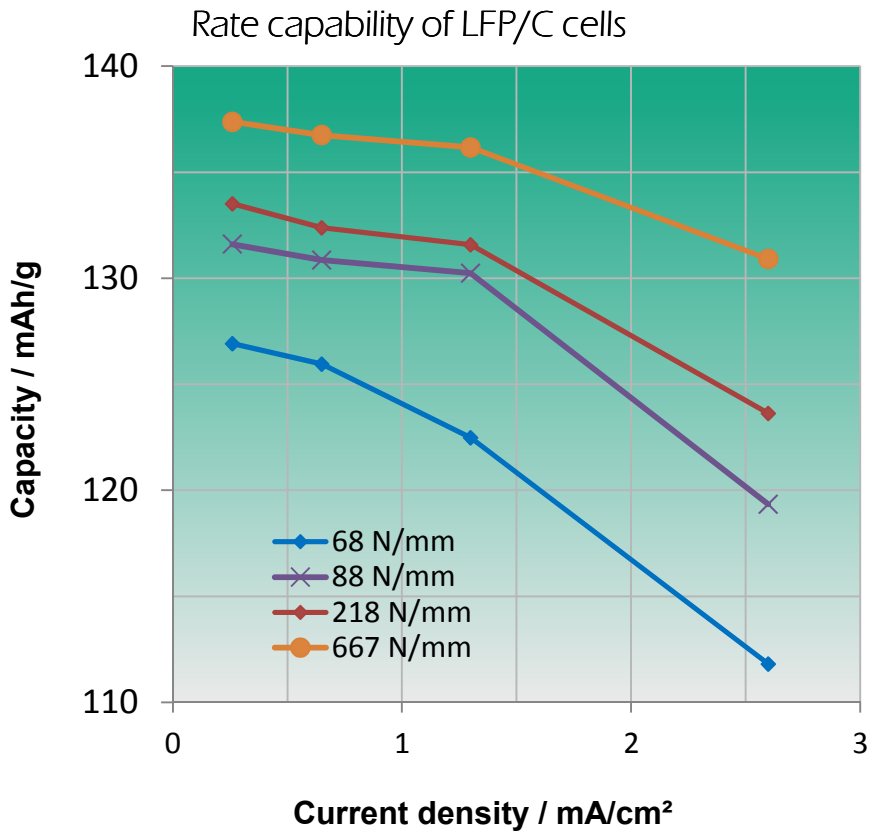
Understanding process parameters II

- Calender force is used to adjust electrode porosity
- Porosity has significant influence on rate capability
- Calendering enhances electrical inter particle and particle to current collector resistance



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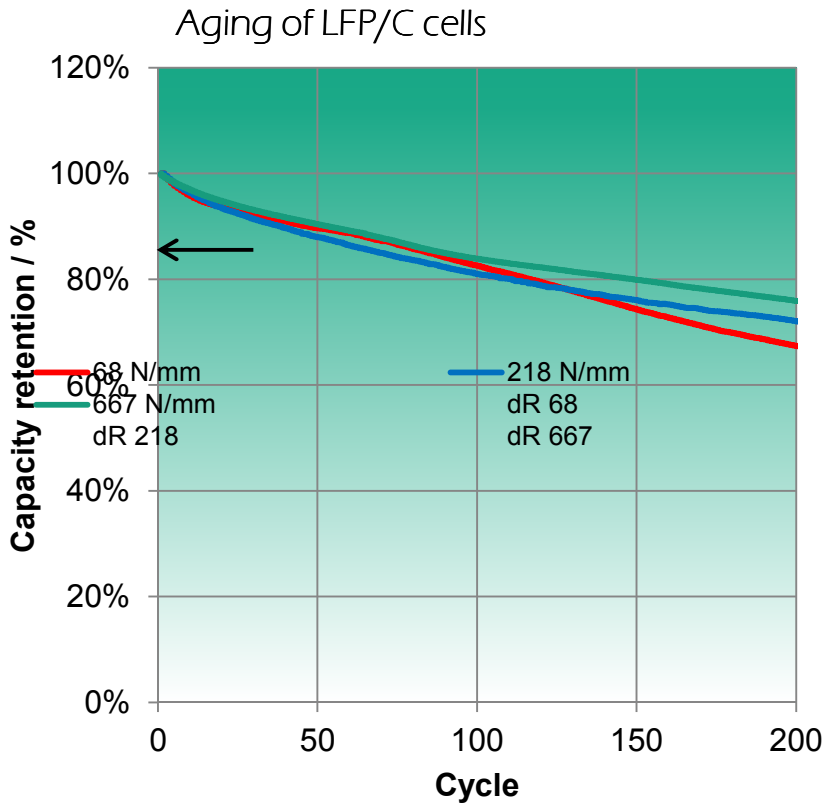
Understanding process parameters III

- Calender force is used to adjust electrode porosity
- Porosity has significant influence on rate capability
- Calendering enhances electrical inter particle and particle to current collector resistance
- Higher adhesion & cohesion of active layer to electrode
- Optimized capacity retention



2C-Cycle test at 60°C

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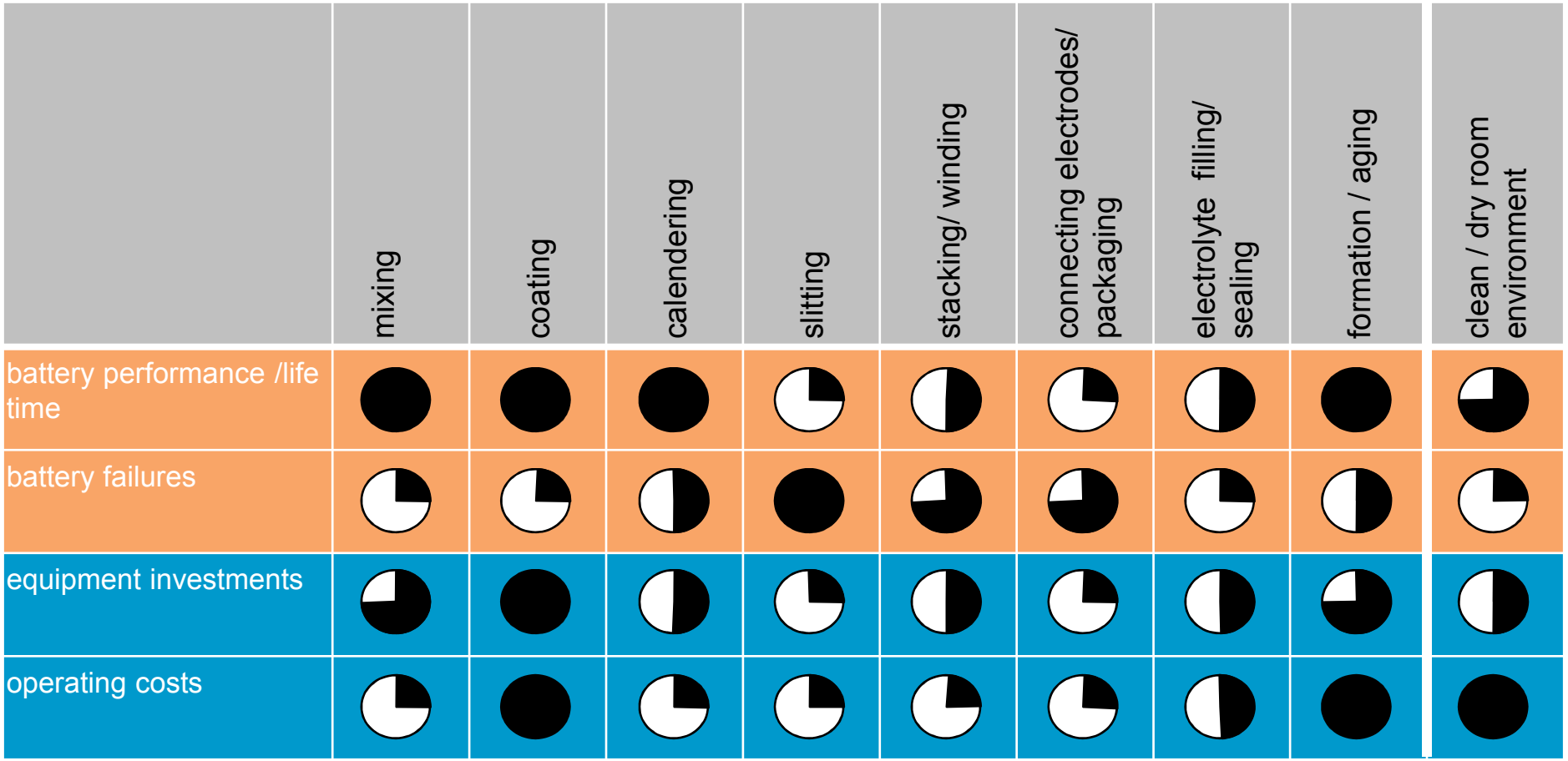
Process development and optimization for Li-ion battery production

- Relevance of process steps regarding battery quality and costs



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Process development and optimization for Li-ion battery production

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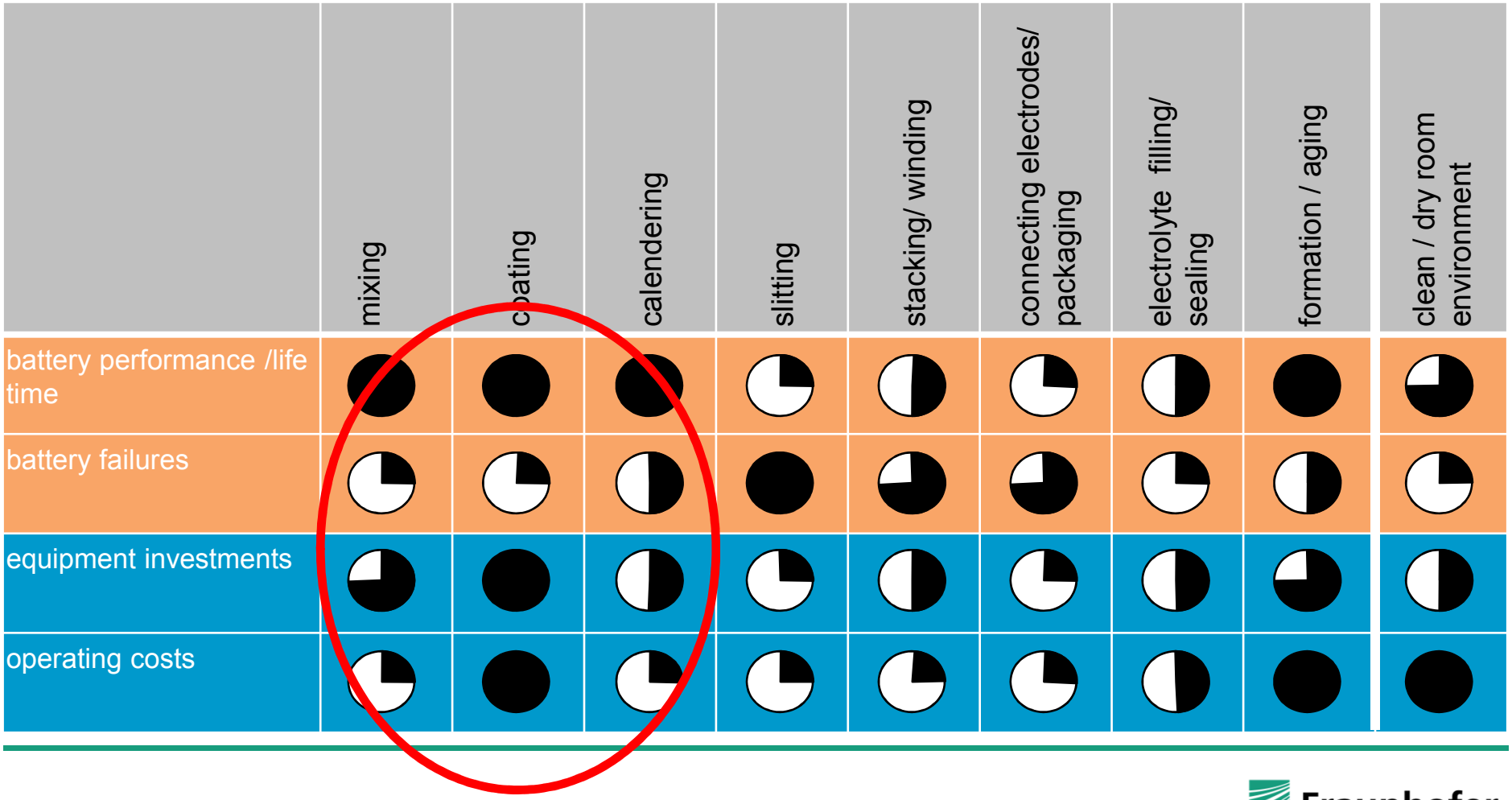

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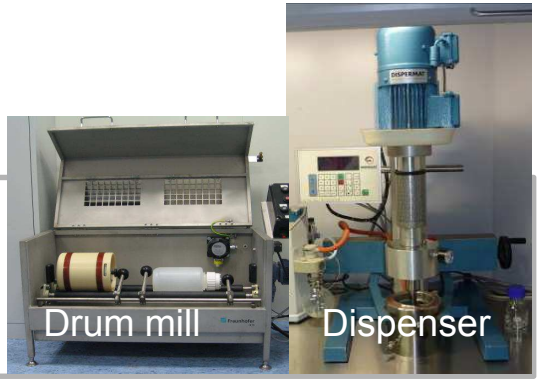
Investigating process optimization I

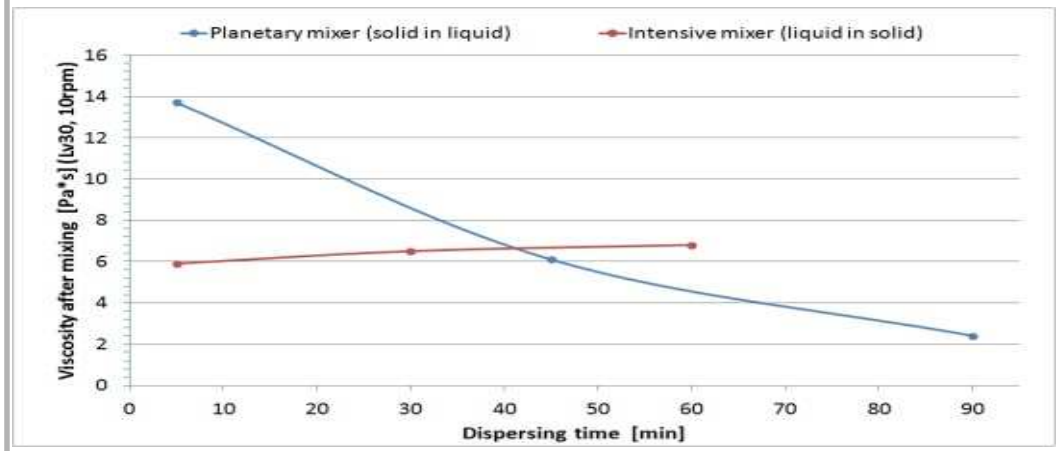
Mixing at lab scale

- Material and recipe development



Mixing at pilot line scale

- Investigation of mixing parameters and technologies
- Optimization mixing time



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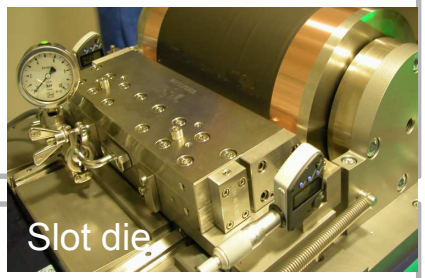
Investigating process optimization II

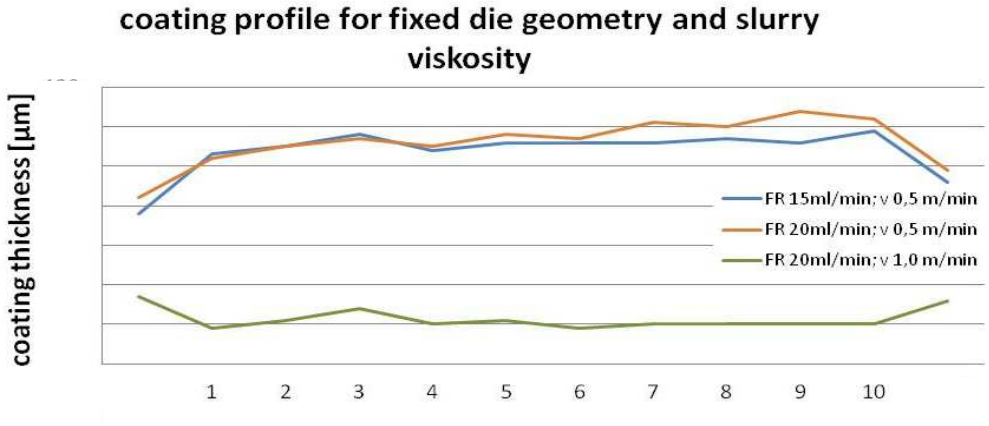
Coating at pilot line scale

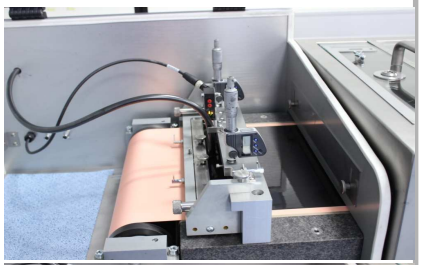
- Process stability, defects

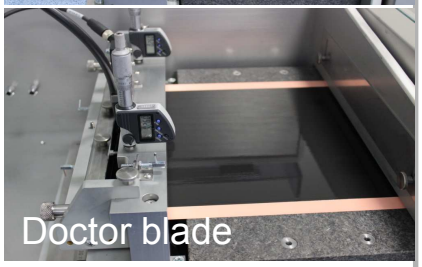


Coating at lab scale

- Effect of slurry properties regarding coating quality
- Development of coating technologies







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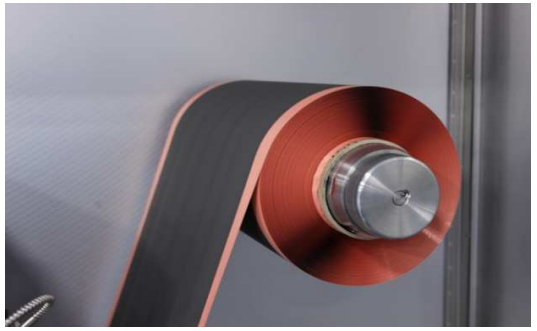
Summary



- IKTS is working along the entire process chain of LIB electrode manufacture and characterization

- Process development and optimization for Li-ion battery production results in a series of complex processes with many parameters and diverse optimization goals → DoE
- Depending on development goal work has to be done on lab or pilot line scale
- Never forget the strong interaction between technology and product properties!

Thank you for your attention!

Special thanks to:

- the European Regional Development Fund (ERDF) and the Free State of Saxony for funding of this work
- our Co-workers in the project LiFab

ThyssenKrupp System Engineering

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