At the CORE of Umicore's
Battery Materials

Umicore's future-proof innovation approach

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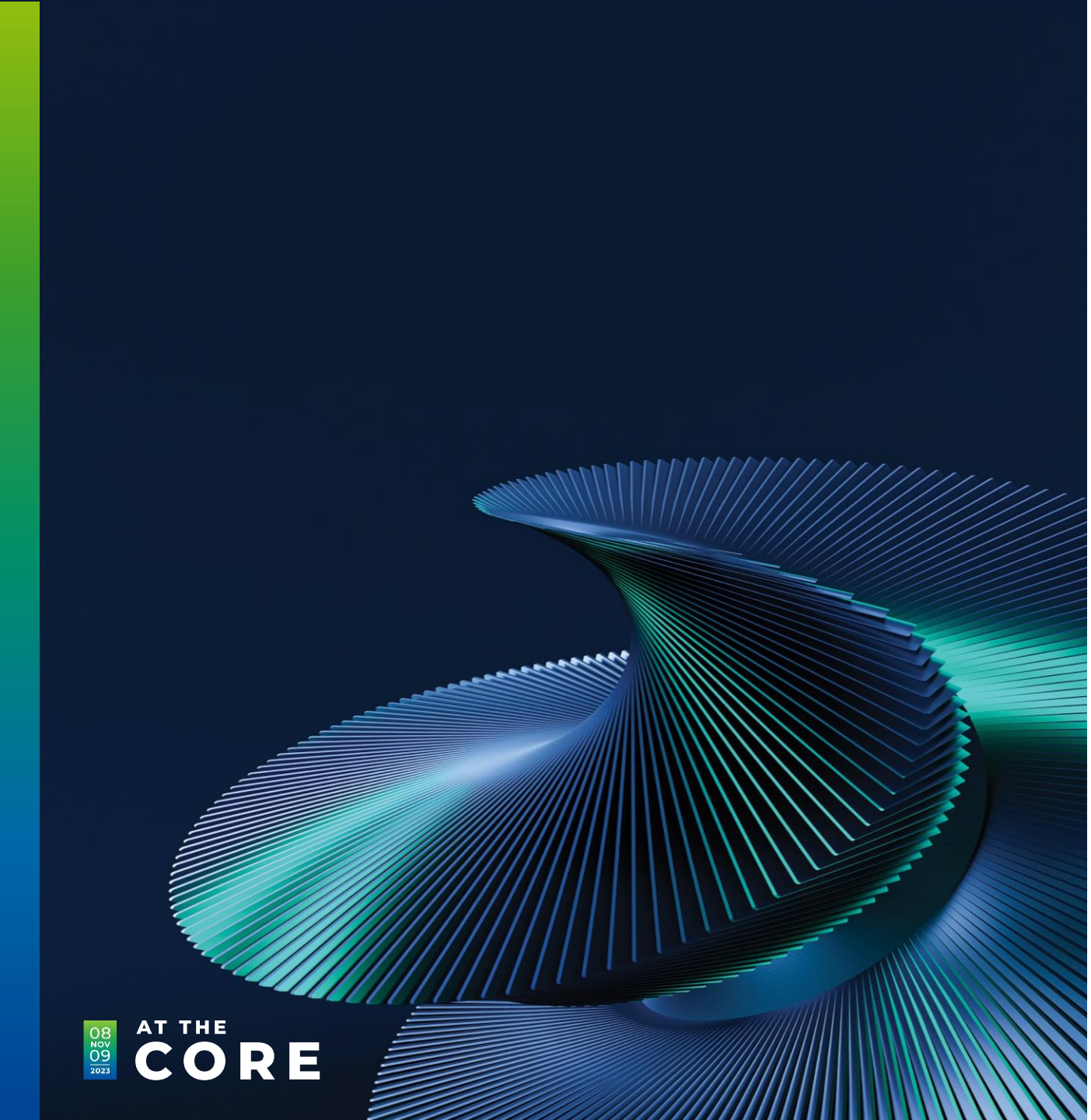
Chief Technology Officer



Agenda

1

CAM is the key technological lever

2

Innovation as cornerstone

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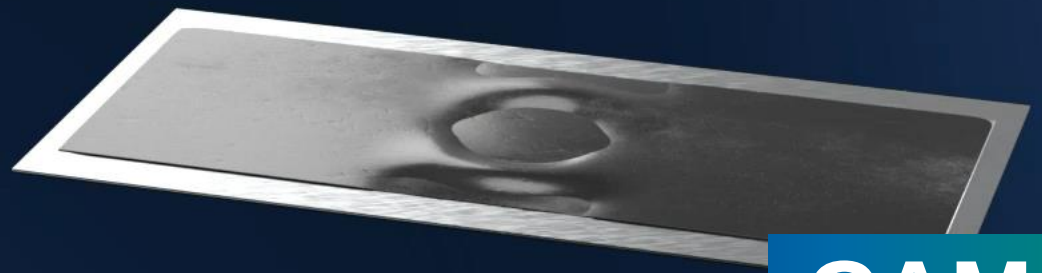

CAM is the key technological lever

for battery performance

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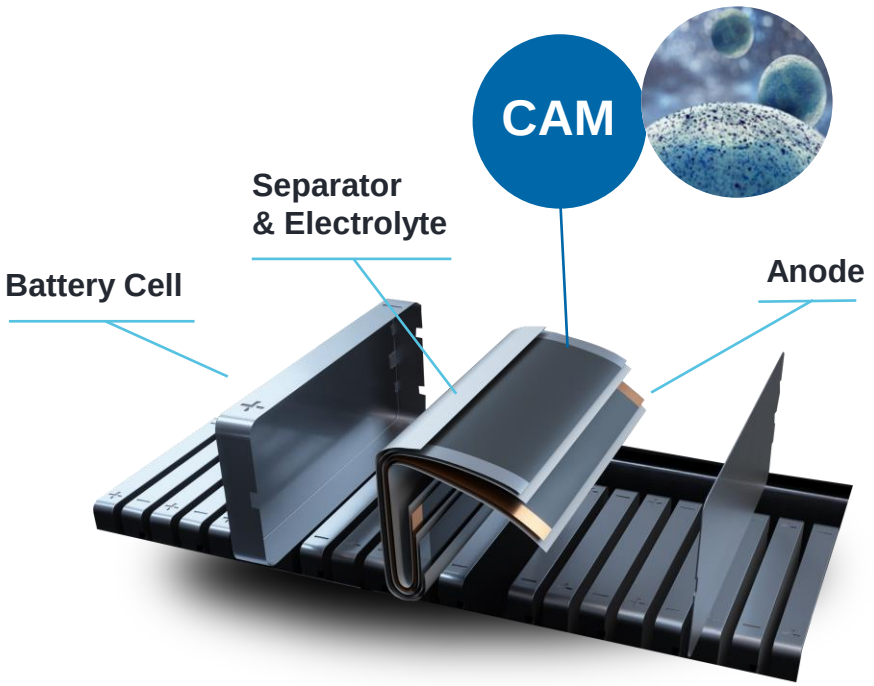
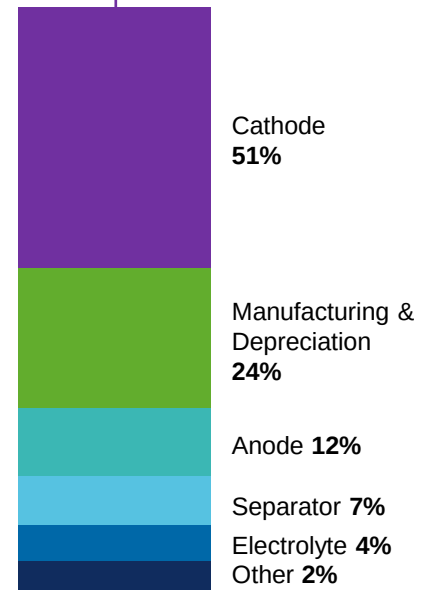
CAM, high-tech component at the heart of electrification

Central to battery value creation



Largest value component of Li-ion battery
(of which ~20% technology premium)



Li-ion battery cost breakdown

- **Cathode** is the **source of Li-ions** in Li-ion battery
- **CAM** technologies differentiate by **chemistries** (e.g. NMC, LFP, HLM)
- **CAM is the key technological lever for performance:**
  - Durability
  - Safety
  - Energy density
  - Charging time
- Defines battery's **value** (~50%) **and overall carbon footprint** (~60%)

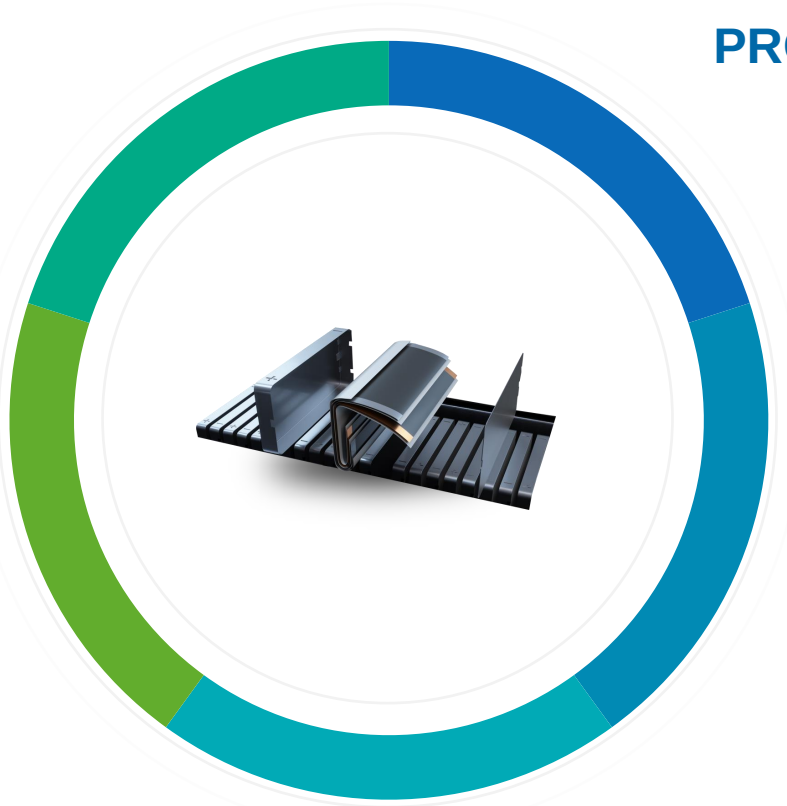
CAM market has high-tech entry barriers …

… with ample opportunities to differentiate and gaining competitive advantage

PRODUCT INNOVATION

Complex customer landscape with **diverse technology roadmaps & continuous product innovation**

Strictest **customer quality** requirements **& long qualification cycles**



PROCESS EXCELLENCE

Highly complex production process

High capital intensity

Critical supply security

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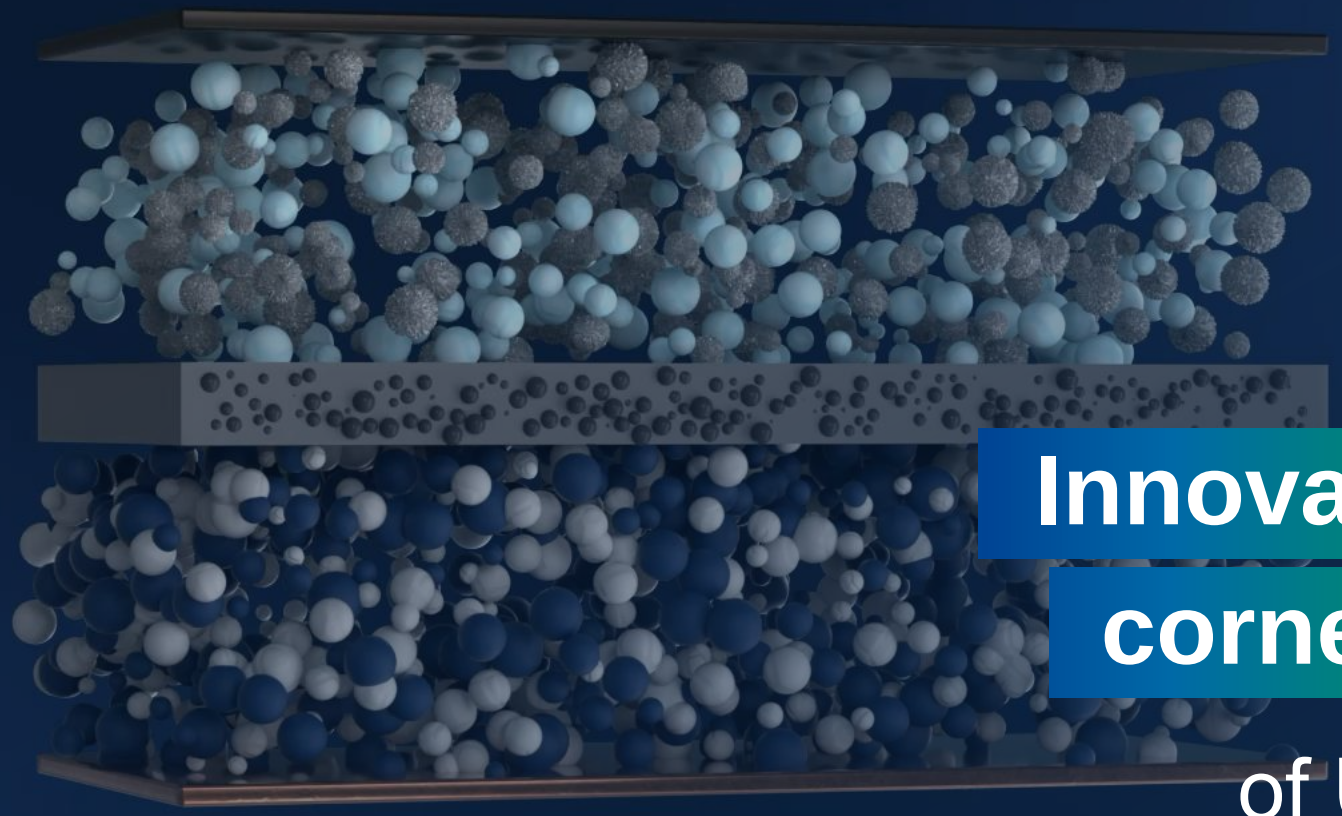

Innovation as cornerstone

of Umicore’s technology leadership

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Future-proof innovation set-up

From early technology screening to robust product design

Corporate innovation:
ecosystem feeding long-term innovation funnel

- Market & technology intelligence
- Open innovation & partnerships
- Development and broad sampling of next-generation technologies

Business Unit innovation: product development with customers and manufacturing at scale

- Feedback of customers translated into innovation funnel
- Development of short- to mid-term chemistries
- Product validation & industrialization to customer specs

Next-generation → Short-term

Unlocking technologies with long-term game-changing potential

Securing innovation pipeline based on customer needs

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Global Umicore Battery Materials innovation presence

Umicore has unique access to a global pool of expert talents

8%

of 2022 Group revenue (excl. metals) spent on innovation across all businesses

~ 400

Umicore battery materials researchers and scientists

> 1,300

Umicore group researchers and scientists

Existing R&D facilities

130

Olen, Belgium

70

Kokkola, Finland

200

Cheonan, Korea

New sites

Loyalist, Canada

Hanau, Germany

Shanghai, China

Innovation ecosystem as key driver

Co-creating and co-innovating

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ACADEMIA:

Leading battery material academic groups

DALHOUSIE UNIVERSITY
COLLÈGE DE FRANCE 1530
UNIVERSITY OF CAMBRIDGE
Berkeley UNIVERSITY OF CALIFORNIA
UC San Diego
LRCS

VALUE CHAIN PARTNERS:

Start-ups and industry leaders

idemitsu
nanoOne
BLUECURRENT
Solid Power

Cell makers and car OEMs

LG Energy Solution
AESC
SAMSUNG SDI
PowerCo
Chinese cell OEM
STELLANTIS
ACC AUTOMOTIVE CELLS Co

60
University partnerships

>200
Technology partnerships

Performing collaborative projects, sponsoring research and co-authoring scientific papers

Co-developing materials & processes through joint development agreements and strategic partnerships

Engaging with applied R&D teams for program execution, and advanced R&D teams for innovation roadmap

>170
Joint tech development projects

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Snapshot of publicly disclosed partnerships

From material science to customer application

End-to-end innovation for best product performance

1

pCAM innovation

Industrially scalable, highest quality micro-engineered pCAM to meet CAM requirements

2

CAM innovation

Process innovations, dopant additions and application of coatings to boost CAM performance and meet customer requirements

3

Battery-level testing

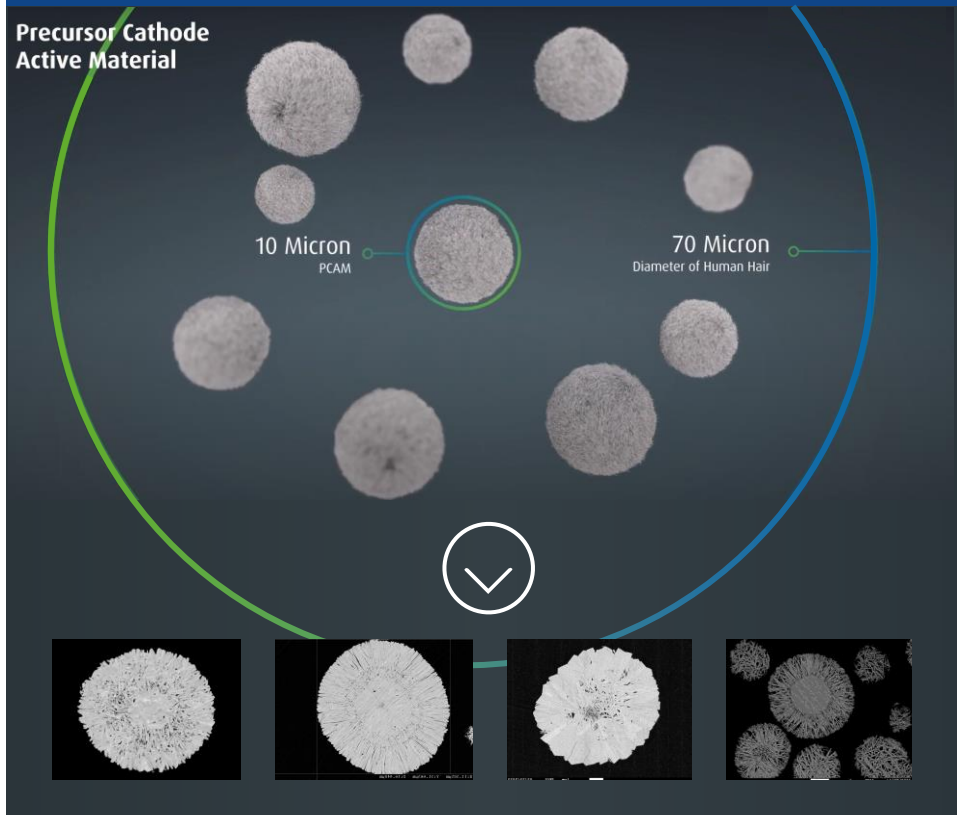
Coin, pouch and prismatic cell testing; evaluate pCAM and CAM innovations; provide material performance data to customers (handshake)

Leading-edge IP generation since 1998
with ~200 active patent families in place

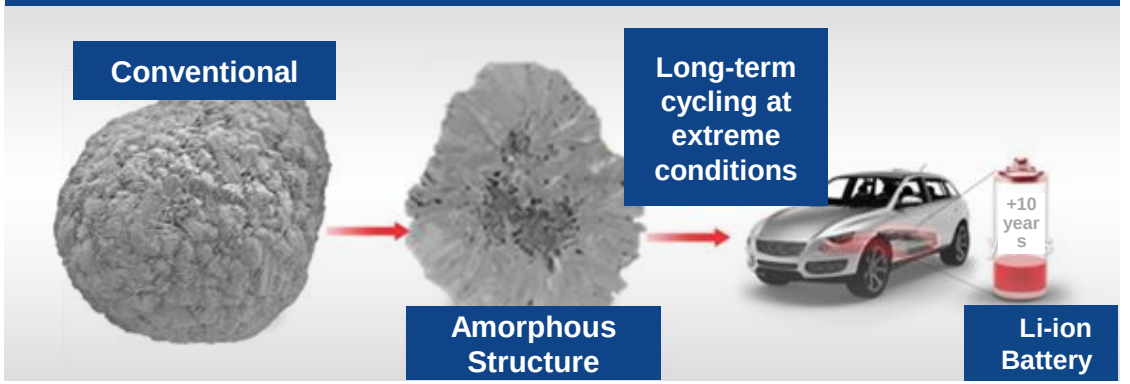
In-house pCAM innovation

Enabling Umicore's differentiated CAM portfolio

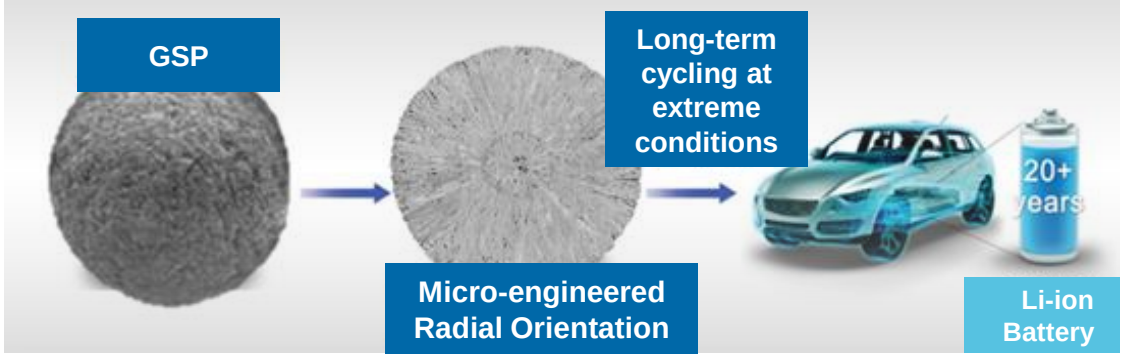
pCAM is 1/7th of the diameter of a human hair



pCAM innovation is key for CAM performance



NEW UMICORE DNA



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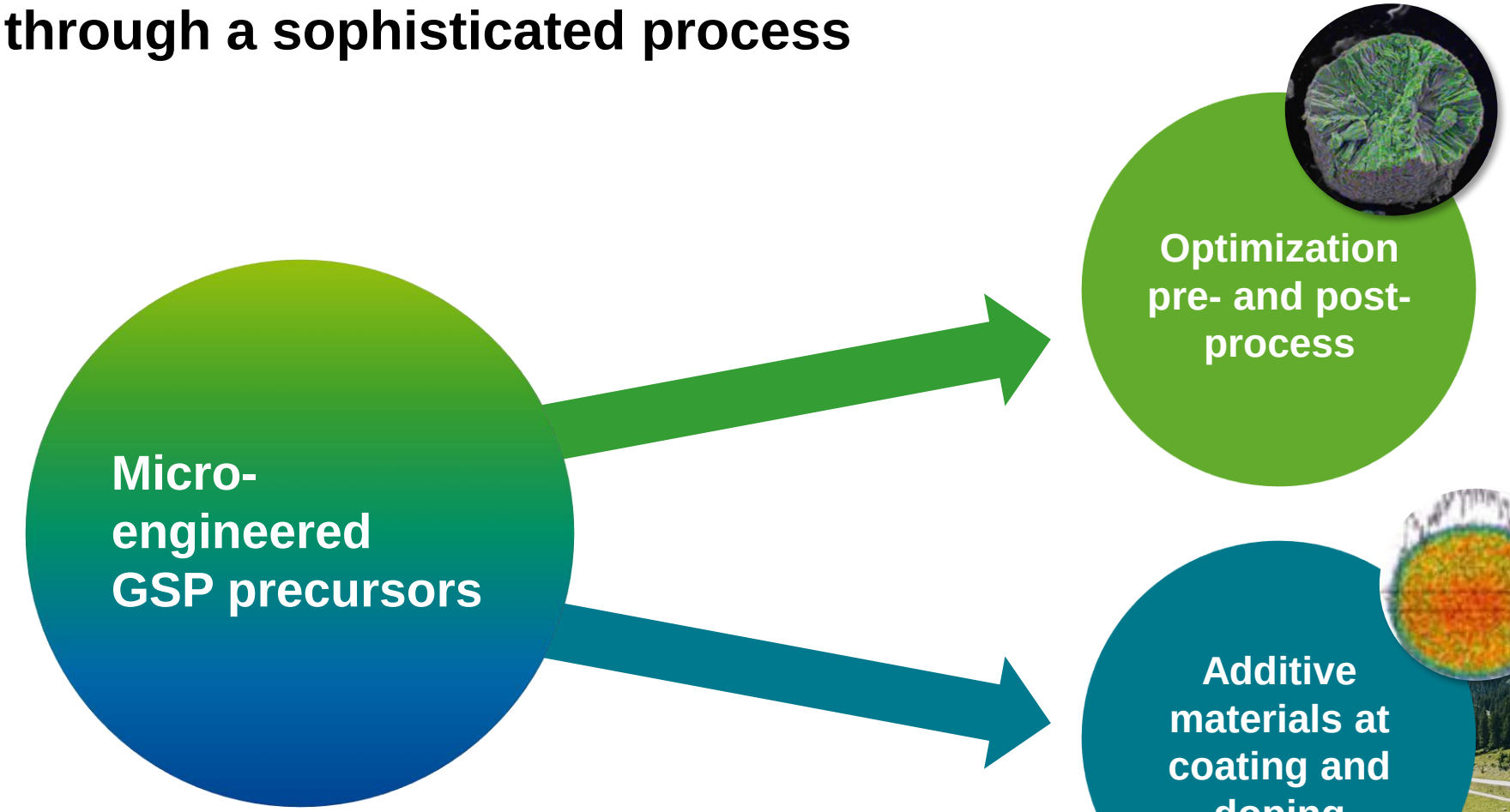
Innovation of CAM starts with pCAM

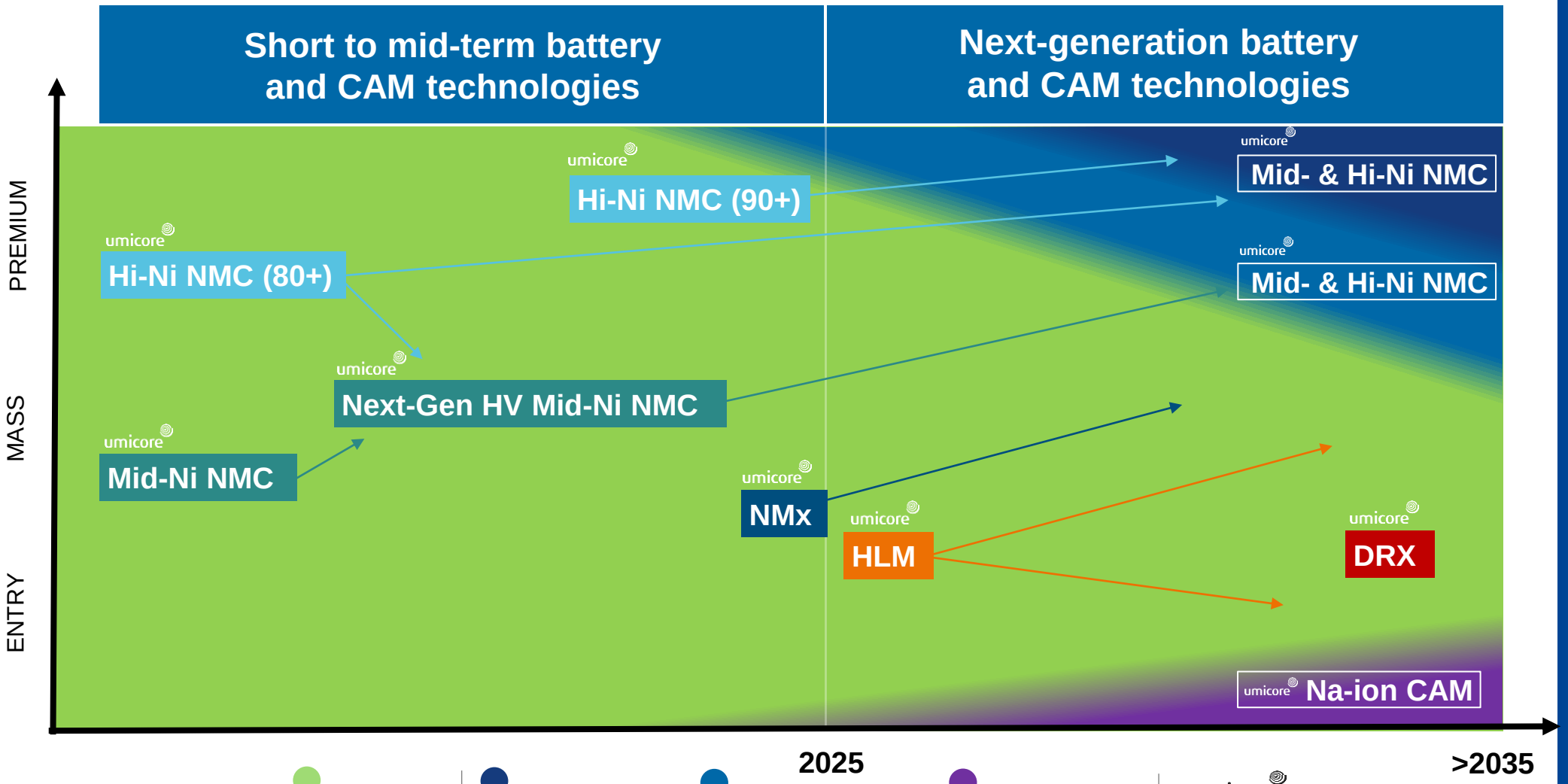
through a sophisticated process



Coin, pouch and prismatic battery cell testing

> 3,000 high-end testing units to ensure precision and reliable results

Delivering a robust and future-proof technology portfolio



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Liquid Li-ion battery

All-solid-state battery

Semi-solid-state battery

Na-ion battery

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Umicore's innovations translate into a robust and future-proof portfolio of advanced and customized battery material technologies, covering the requirements of today's and tomorrow's entry, mass and premium EV platforms

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