Advanced Materials for Sustainable Energy Harvesting & Storage

Meeting of EP Intergroup CCBSD
Sustainable Chemistry: Supporting Research, Innovation and Competitiveness in Europe
November 13th 2013 - Brussels

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Umicore in a nutshell

- We are a **global materials technology company** (14,600 people, 79 sites, > 50% sales in Europe, Turnover 2012 @ 12.5 B€ or 2.4 B€ excl. metal value)
- Our mission is to make “materials for a better life” (from metals to high-tech applications)
- The majority of our **growth comes from clean technologies**
- We use application know-how to create **tailor-made solutions** in close collaboration with our customers
- We **close the loop and secure supply** by recycling production scrap and end-of-life materials
Umicore’s development fits with sustainability-driven megatrends

**Electrification of the automobile**
We are a leading producer of key materials for rechargeable batteries for laptops, mobile phones as well as electrified vehicles.

**Resource scarcity**
We are the largest recycler of precious metals; we are able to recycle more than 20 different metals.

**More stringent emission control**
We provide catalysts for 1 out of 3 cars in the world as well as for trucks & non-road vehicles.

**Renewable energy**
We supply key innovative materials for high-efficiency solar cells and other photovoltaic applications.
EU faces strong energy challenges and has set ambitious goals and priorities

EU “20-20-20” Targets by 2020:

- **Competitiveness**
  - Cut Europe’s energy bill
  - Create growth & jobs
  - Boost R&D where EU can become a global leader

- **Security of Supply**
  - Decrease EU’s energy dependence
  - Help balance trade: single European energy market

- **Sustainability**
  - Fight climate change
  - Limit environmental degradation

By 2050: Reduce GHG levels by 80-95% below 1990 levels

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In a BAU scenario, the power sector would be accountable for ~ 30% of GHG emissions.

Reducing CO2 emissions relies upon innovations in energy efficiency, sustainable energy harvesting & storage.
Advanced Materials facilitate deployment of sustainable energy technologies

_Umicore helps with its innovations_

Materials for ENERGY HARVESTING

Materials for ENERGY STORAGE

Materials for ENERGY DISTRIBUTION

Materials for ENERGY EFFICIENCY
Energy Storage using Li-ion batteries could enable a EU value chain while solving sustainability challenges

- Large storage potential forecasted (BCG 2013) with EU stronger than Japan, China and ROW
- Batteries 2 times more than Hydrogen & together >80% of the market

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<td>LiCoO₂</td>
<td>lithium cobaltite</td>
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<tr>
<td>LiMnO₂</td>
<td>lithium manganese oxide</td>
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<td>NMC</td>
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<td>Li(NiₓMnᵧCo₁₋ₓᵧ)O₂</td>
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<tr>
<td>LiFePO₄</td>
<td>lithium iron phosphate</td>
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Developing products with suitable cost & performance requires strong materials R&D

Different NMC material generations are being developed

- Reducing cost/kg
- Increasing kWh/kg

\[ \Rightarrow \text{Reducing cost/kWh} \]

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<th>Year</th>
<th>NMC Generation</th>
<th>Details</th>
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| 2011-2012 | Generation 1 | Higher Ni content pushes energy density: 
- Increase kWh/kg
- Maintaining cost/kg
\[ \Rightarrow \text{Decreases cost/kWh} \] |
| 2017 | Generation 2 | Lower Co content reduces metal cost:
- Decrease cost/kg
- Maintaining kWh/kg
\[ \Rightarrow \text{Decreases cost/kWh} \] |
| 2019-2020 | Generation 3 | - |

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Technologies for sustainable energy harvesting & storage require “technology” metals, some being critical for EU

Critical materials (EU): Be, Co, Ga, Ge, In, Mg, Nb, PGM, REE, Sb, Ta, W, fluorspar, graphite

Geopolitical concerns
- REE in China
- Pt in Southern Africa
- Co in Congo
- Li in the Andes
- Pd in Russia
Impact for Advanced Materials Scientists?

Functional properties & performance are at the heart of materials but additional aspects need to be considered

- Availability of needed elements
  Is there enough, can we get access, will the price remain affordable?
  → Critical metals

- Can the specific (critical) materials be recycled at their end-of-life (as alloy and/or element)?

- How can we design a product in a way that the “critical” components remain accessible for separation and recycling?

- What impact does the substitution of critical materials have on the recyclability of the product/component?

- What is the most promising approach for sustainable use of critical elements – savings & substitution or improved recycling?
Advanced Materials for clean energy & EU?
EU is facing growing global competition

- Difficult to match investment project incentives available in competing regions
- Other regions strongly focus on strategic manufacturing to fight off competition
- EU does the basic research, others commercialize advanced products & processes
- Asia is moving up traditionally EU value chains due to fast catch up in innovation

EU needs to reinforce & develop its assets to compete

- EU has considerable assets in global advanced materials competition (leading research organisations and companies in several applications)
- EU is still strong in global race for patents (2nd)
- The disconnect between R&D and Innovation (manufacturing and commercialization) is HOWEVER present
- Involvement of Industry must be stimulated & facilitated such as would be the case in Horizon 2020

Global patent and manufacturing shares for Li-ion batteries
Organizations active in adv. materials for low carbon energy technologies teaming up in EMIRI

EMIRI is a European industry-driven grouping (40+ organizations incl. leading materials companies) with goal to:

- Establish Industrial Leadership in EU
- In advanced materials for competitive low carbon energy in line with the SET Plan goals and its materials roadmap
- Through involvement of all stakeholders for strategic RESEARCH & INNOVATION programmes (use more effectively resources available at EU scale)

EMIRI is the organisation to:

- Propose a cross-cutting focus to develop advanced materials for low carbon energy
- Be based on SET Plan Materials Roadmap
- Span the entire innovation value chain to achieve commercially successful development of advanced materials for energy applications in Europe