Hybrid Energy Storage Devices and Systems for Mobile and Stationary Applications

MP1004

Start date: 02/05/2011
End date: 01/05/2015
Year: 4

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Scientific context and objectives

One of the biggest challenges in the development of appropriate energy storage solutions:

Wide range of requirements in transport and energy technique even within one specific application – multiple interrelated factors to be satisfied and considered simultaneously.

Hybridization = opportunity
Market Segments

- **Mobile applications**
  - Automotive (Cars, buses and trucks),
  - Rail (heavy rail vehicles, tramways and metro)

- **Stationary applications**
  - Renewable energy systems (including wind power and solar applications)
  - Power Quality & Uninterruptible power supply (UPS) systems
  - Emerging applications
Energy Demand in Transportation

- **Energy Boost for Engine Start and Acceleration**
- **Recuperative Braking**

Energy Acceleration

Regular Mode

Braking

**inner-city stop & go mode**

**Short term energy supply/akkumulation; high power density**

**Energy Boost**

**Engine Start**

**Energy Recovery**

**t**
A major scientific challenge is to either significantly increase the energy density of conventional supercapacitors or dramatically improve the power density of lithium ion batteries.
Scientific context and objectives

**Approach:**
Intelligent combination of the advantages (of different individual types of energy storage) while disadvantages are cleverly masked

**Additional aspect:**
- Number of common themes within the research on individual types of energy storage devices e.g.:
  - functional material research
  - tools & technologies for materials processing
- The potential for learning from each other has not been sufficiently exploited yet
Ideal energy storage & supply

Example: our body as a collection of bio cells with adequate response (energy, power, time etc.)

Forms of energy storage and supply - tailored solution:

- ATP adesin-tri-phosphoric acid - short term response, distributed energy storage and supply
- ADP adesin-di-phosphoric acid - medium term energy supply
- Glycogen - long term energy storage and supply, centrally stored in the liver
Scientific context and objectives

• To provide scientific and technological knowledge to develop innovative hybrid energy storage devices and systems

• To prepare a platform for their adequate practical implementation in transportation and energy technique

• Secondary objectives:
  • Establishment of a Pan-European and multidisciplinary communication platform to support the realisation of opportunities in the field of energy storage solutions – delivery of new impulses for new cross-sectoral multinational co-operation
  • a common understanding of requirements on ESS, identification of current gaps as well as detection of ways to overcome the gaps, road mapping for S&T development in the entire field
  • Active involvement of ESR`s, promotion of women`s participation, dissemination activities for the related industrial community, policy makers, general public
Working groups

WG1: improved materials for hybrid energy storage solutions

WG2: intelligent hybrid energy storage devices and systems

WG3: hybrid energy storage solutions for mobile applications

WG4: hybrid energy storage solutions for stationary (energy techniques) applications
Results vs. Objectives

• Prototypes of hybrid energy storage devices based on the battery + supercapacitor combination (Li-Ion battery + SC)
• Concepts for the application of hybrid energy storage systems (battery + supercapacitor) in transportation and energy technique (e.g. smart grid): requirements/gaps/barriers/first prototypes & proposals for further prototypes
• Support to the establishment of the national programs and EU-projects
• The added value of networking: establishment of a multidisciplinary international Think Tank with strong ESR’s involvement considering the whole chain approach: material science – system development/application – economical & social aspects
Significant Highlights in Science or Networking

• Think Tank meetings in conjunction with MC/WGs meetings and major international events in the field of electrochemical energy storage:
  • ISEECAP2013 (Taormina, Italy, June 2013)
  • Workshop in Barcelona (January, 2014)
  • Organisation & realisation of the meeting
    • short high level talks to set scene
    • round table discussions
  • Tutorial for ESR’s in conjunction with the ISEECAP2013
Significant Highlights in Science or Networking

the 3rd International Symposium on Enhanced Electrochemical Capacitors (ISEECap2013) in cooperation with the International Electrochemical Society that will be held in Taormina, on 3-7 June 2013.

142 attendees coming from 24 countries across the five continents.

The program of the conference: 9 sections, started with 4 tutorials lectures for ESR’s, 7 keynote talks, 45 oral presentations and 72 posters, 2 awards of Electrochemical Society for best poster presentations by ESR’s.

Selected manuscripts presented at ISEECap2013 published in a special issue of the “Journal of Applied Electrochemistry” by Springer.
Significant Highlights in Science or Networking

- Active involvement into activities of the EASE/EERA Core Working Group: Development of a Joint EASE/EERA recommendations for a European Energy Storage Technology Development Roadmap towards 2030
- Support for successful realisation of the project
- In frame of Marie Curie program: EMVeM (“Energy efficiency Management for Vehicles and Machines”) is an EC Marie Curie FP7 Initial Training Network project Nr. GA 315967 (2013-2016). The main aim of the project is to establish a training network for Ph.D. students on methodologies to increase the energy efficiency of vehicles and machines.
- Support to national programs in Poland, Norway, Israel, Portugal, United Kingdom, to bilateral programs (Israel-France, Spain-Portugal)

- Science:
  - hybrid battery-supercapacitor prototypes available
  - innovative technology for the processing of electrode and current collector
Challenges

• Further development of a “common language” within the Action and with other partners - Actions
• Further development of prototypes of hybrid energy storage devices and systems (both in transportation and energy technique)
• Critical issue: possibility to get more funding for “hybrid energy storage solutions” (international & national level) and more intensive industrial involvement
• To get more “fresh minds & fresh ideas” – huge potential available by the ESRs and multidisciplinary cooperation
Action Parties

Grant Holder:
WTTC
Dalik Sojref
Germany
Action participants

- Total no. of indiv. Participants
- ESRs
- Female
## Use of COST Instruments

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