First and Second Life Battery Use

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- Duration: 3 years
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Lithium ion battery, first and second life, aging

Description of Thesis

It is generally agreed that the vehicle propulsion mode has to change in order to limit the emissions of green house gases and to limit global warming. France even plans to ban the sale of purely combustion engine based vehicles by 2040. Lithium-ion based electrochemical accumulators seem the best mean to store electrical energy produced by renewable energies for a use in land vehicles. Even if their development is already advanced [1, 2], there still is a system approach missing. Business models on electrochemical accumulators show that their use is only interesting if the total lifetime is taken into account, including production, first life use in a mobile environment, second life use in stationary environment and recycling [3]. The objective of the project is to better understand the aging of batteries during first life and the consequences on second life.

In a first step, use profiles of electrochemical accumulators for electric and hybrid vehicles will be identified. It is expected that the use profiles differ considerably: electrochemical accumulators in hybrid vehicles are used as power sources with a great number of cycles and considerable power variations, but a limited amount of energy, whereas electrochemical accumulators for full electric vehicles are used as energy sources with limited power supply, but a high variation of energy. A third aspect is the study of the use of electrochemical accumulators in a stationary second life utilisation.

Key aspect of this thesis is the in depth study of the aging of electrochemical accumulators according to different use profiles in first and second life, with a special interest to understand harmful working modes. It is preferred to support the study with experimental results that might be obtained by other research projects conduced in the research group or obtained from experiments executed on equipment available in the research grouped. However, it is also important to base part of the work on the multiple publications in the research area. An important aspect is the definition of the most adapted electrical and thermal cycling. Another important aspect is the method to identify cause and effect relations. Finally, it would be interesting to study the advances in standardisation on accumulator testing.

Based on the results obtained during the PhD thesis, recommendations for lithium ion battery use in first and second life application will be elaborated and linked to existing studies of electrochemical accumulator aging [4] or fuel cell aging [5]. A prediction of the crucial working points of a second life use of lithium ion batteries has to be established. The expected results of

the PhD thesis will contribute to a global vision of the use of lithium ion batteries during their entire life.

Expectations from the candidate

The candidate is required to have obtained a master of science, or equivalent, in the domains energy, electrical engineering or related. A first experience in scientific document writing and research work in the domain of energy storage will be positive. Mastery of Matlab / Simulink and LabView software is important. A good English level is requires as also an adequate French level and a strong wish to integrate to the research group and the environment. The candidate has to show a huge motivation and work autonomy as well as good communication skills.
To apply, please send your CV, motivation letter, transcripts and recommendation letter to daniela.chrenko@utbm.fr

Thesis supervision

- Daniela Chrenko, Thesis Director
- Samir Jemei, Supervisor
- David Bouquain, Supervisor

References

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