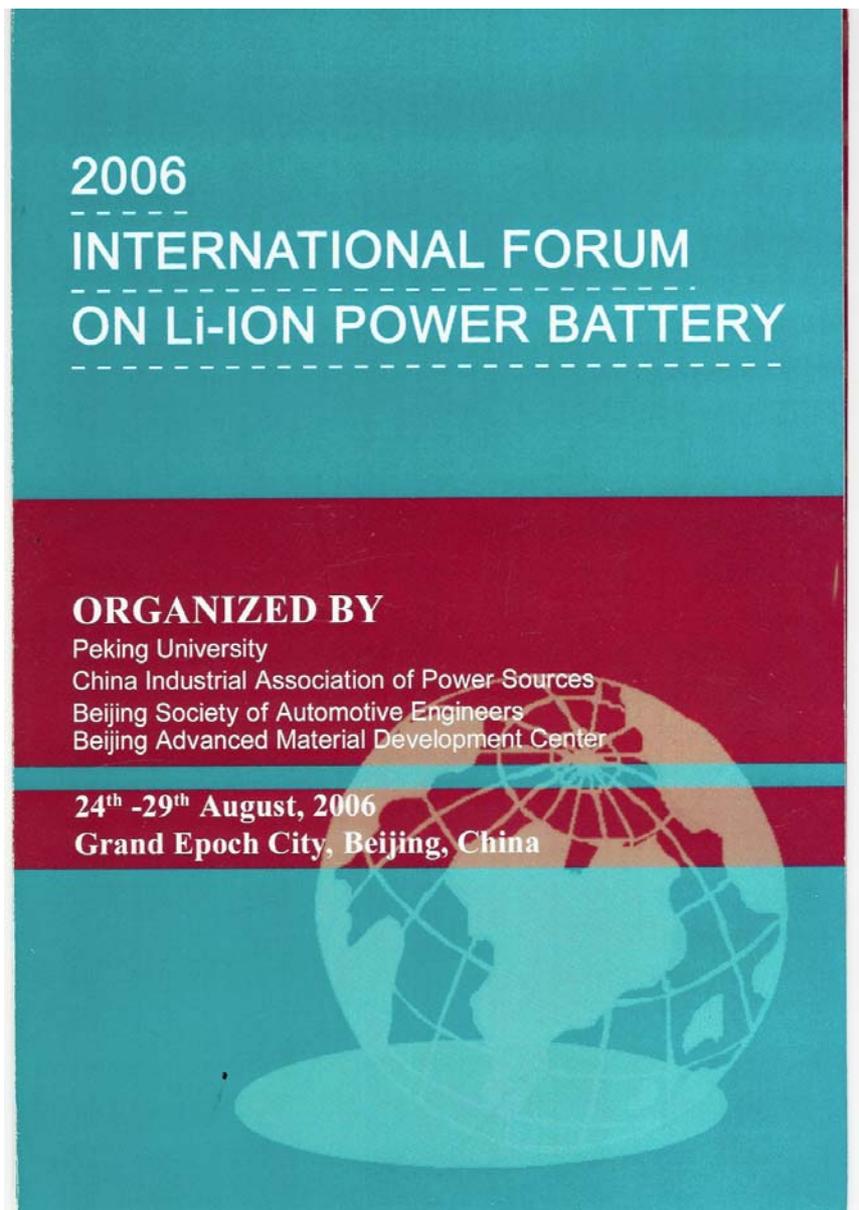


“The emerging world market for safe and large format Li-Ion Batteries,  
Hybrids, a new innovative EV generation,  
Trends & GAIA Akkumulatorenwerke (a LTC company)  
And: The new EV.age is born!”  
Interview with Tim Schaefer  
(GAIA/LTC Germany/USA):



*For the Academic Commission of: “The 2006 International Forum ON Li-Ion Power Battery”  
Grand Epoch City, Beijing, China, August 2006, Chairman: Dr. QiLu (Professor Peking University)*

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**World’s Emerging Markets for safe & Large Format  
Li-Ion Batteries (2006 – 2012)  
The new EV.age is born!**

Staff Editor: What is your perspective on the current market status and prospect of lithium-ion power battery?

*Tim Schaefer: The emerging world markets for safe and large-format Li-Ion batteries offer immense growth potential. Electric and Hybrid Vehicles offer a uniquely attractive solution to many of the issues currently facing the automotive industry, but the technical and marketing challenges are still remarkable. Criteria are fulfilled, Li-Ion and Li-Ion polymer batteries, since they provide high-energy capacities and, hence, longer running times, are lightweight and of a compact size and above all also safe! The energy and power advantages offered by lithium-ion batteries relative to other chemistries have made lithium-ion a preferred battery in the high-energy and high-power, rechargeable, advanced market segment. While the World industrial secondary lithium battery market offers immense potential in terms of growth, there are some major challenges that need to be countered before moving on. These include safety and transportation issues, competition from other participants in terms of low-cost cells, rising prices of raw materials which directly translated into higher prices of batteries.*

*Because of low costs and a dependable service in case of adverse environmental conditions, lead-acid will record a final, increasing period until the year 2012. Lithium-based batteries will start to replace many lead-acid applications if the price can be lowered and the service/marketing is prolonged.*

*The emerging world market for large-format, secondary lithium batteries consisting of lithium-ion (Li-ion) and lithium-ion polymer (Li-ion poly) is booming, as this chemistry offers improved features compared to the traditional battery chemistries. Li-ion is poised to outperform NiMh and, step by step, lead-acid systems in various applications (2000-2025).*

*With no major breakthrough, the fuel cell will probably play an insignificant role in providing power for future application. Cost, size, and performance are the main obstacles.*

*Although continuously in operation by replacing fuel capsules, the fuel cell, as we know it today, still needs a backup battery to satisfy the power requirements of modern portable equipment.*

**SE: Are there any possibilities that GAIA may consider entering the lithium-ion power fields.**

*Tim Schaefer: Everybody is talking about hybrid-cars. But only (in Germany) the research and development department of VW seems to have a real interest in producing a genuine fully EV in the near future. Ford, VW (Hybrid's) and others are interested in NiMh by Sanyo. There is even a form of collaboration with regards to the design in center a Ford in the US. A Li-Ion is possible from Asia in the near future if Johnson Controls with Varta and SAFT as an alliance are not to be preferred. In Europe, there are some really noteworthy plans; what is e.g. Bosch doing? A full hybrid demonstration vehicle from Siemens VDO will be on the road by the end of the year, according to the German tier one supplier. Steps ahead in an ever changing world: "Do not imitate HEV, innovate EV's!"*

*Others are in the course of building up capacities for innovative materials including nanomaterials for Li-Ion. In this context, especially Bayer Material Science, Südchemie, BASF, SGL Carbon, and Degussa or Gould has to be mentioned. Other European companies are Umicore, Solvay or Arkema. Nanotechnology may probably soon bring some advantages (for instance NCT's as additives), but then, of course, probably for all types of energy (storage) devices such as super caps or batteries. Even Europe is well-prepared for the recycling process of Lithium-Ion.*

*In my view, a nice EV of the new generation will find an attractive market in Europe due to safe Li-Ion with manufacturers earning much money. There are parallels with the LEV market which has already been successful as shown by Sparta from the Netherlands. For HEV it is a different case.*

*Let's say it again: Don't imitate hybrid, innovate EV's!*

*A manufacturer introducing a new electric car should not only set new standards with regards to driving pleasure, range or lifespan/cost effectiveness, but should also consider some important questions on*

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marketing and design. Preliminary results of an acceptance survey study for German market on new generations of EV are shown in one paper. You need excellent technology know-how and a lot of time for testing. It is obvious that the mainstream taste has to be met and the younger generation has to be appealed; perhaps to create a completely new awareness of life by means of an electric car in a new, beginning new EV-age.

*The new EV.age is born, based on large format Li-Ion batteries!*

**SE: If GAIA decides to enter the lithium-ion power battery industry, what would be the technological source and input?**

*Tim Schaefer: Lithium Ion batteries offer the greatest amount of energy and power for a given size or weight of all commercial rechargeable battery systems. Lithium battery technology has a long history and has gone through many different forms and chemistries. Lithium batteries had their immediate applications in cell phones, and other portable electronic devices because of their light weight. The chemistry that we are familiar with today goes back to the 1980s. The Japanese demonstrated the commercial viability in the 1980s with the introduction of the 18650 cell. That cell today is the basis of all laptop computers and most portable electronics.*

*In the early days, developers felt that lithium batteries stored too much energy to be made safely in large sizes and that they could never be designed to provide high power. It was only in the last few years that the technical challenge of building large, high energy and powerful Lithium Ion batteries has been met. To understand the relationship of energy and power, consider the analogy of an automobile. The gas tank is analogous to the energy, the larger it is, the farther the car can drive. The motor is analogous to the power, the larger it is, the faster the car can accelerate and the faster it can drive. To be able to compare different battery systems irrespective of their sizes energy and power are normalized per unit weight and volume (specific energy/power and energy/power density).*

*LTC's unique technology allows for the production of very large cells with a high capacity and high power capacity. These cells form the building block for batteries assembled by electrically connecting them in series and in parallel with an energy content from 10 times the capacity of standard laptop computer battery to 100,000 times greater.*

*LTC manufactures the GAIA® product line of large, high power hermetically sealed cells that are either designed to maximize energy content (HE product line) or power capability (HP or UHP product lines). LTC produces high power cells designed for HEVs and military applications that can discharge hundreds of amps in times as short as a few minutes, and high capacity cells for applications such as back-up power and remote standby installations. LTC manufactures a variety of standard cells in both cylindrical and flat formats that are assembled into custom large batteries complete with electronics (battery management systems) that ensures systems safety and performance and enables the battery to communicate with other components of the system to optimize total performance.*

**SE: What are the advantages and strategic blueprint of GAIA if the Company gets involved?**

*Tim Schaefer: LTC's wholly owned affiliate GAIA Akkumulatorenwerke in Nordhausen, Germany employs a unique patented extrusion process for producing electrodes for lithium ion cells. This process is environmentally friendly (no solvent) and eliminates the need for expensive explosion proof coating and solvent recovery equipment. Using high speed winding and a unique assembly technology, large cylindrical cells are manufactured. In our Plymouth Meeting facility, we have the capacity to build large footprint flat cells and stack them to form large batteries. Our proprietary technology includes critical composition, processing, and packaging aspects of the battery. Our coating, lamination and extrusion know-how enables us to achieve uniformity and consistency through a range of application techniques.*

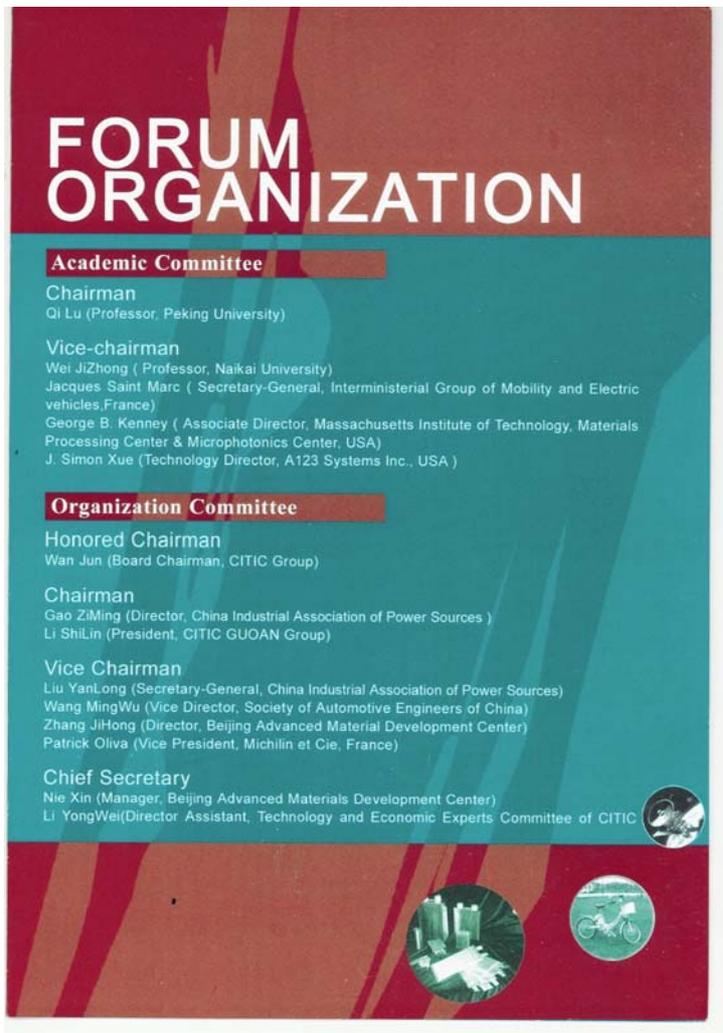
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Batteries for the consumer, transportation, and industrial markets require different electro-chemical systems that we believe can be easily accommodated by our extrusion process.

Batteries are designed based upon specification which determines the specific cell, the number of cells and the configuration. A critical part of every lithium ion battery is the battery management system (BMS). The BMS monitors the cells, keeps them in balance for best performance, reports the state of charge and state of health and prevents damage to the battery due to over voltage, under voltage, over temperature and short circuit.



**SE: Could you give any comments on the Chinese Li-ion battery-powered EV market, related technologies and enterprises? What suggestions would you offer for these enterprises?**

*Tim Schaefer:*

1. Do not imitate Hybrid, innovate EV's!
2. The tier 1 segment of the industrial secondary lithium battery market consists of battery vendors that are global participants operating in more than one region. Common traits include a wide product range that runs across many industries, global manufacturing facilities, a wide distribution network supported by post-sales service, and strong brand recognition. Companies that fall in this tier are for instance Matsushita Battery, Panasonic, Sanyo Energy Corporation, BYD Battery Company, Sony and LG Chem in these days.

*Do we see a new tier 1 company from P.R. China within 2-4 years?  
Good Luck!*

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