

Lithium Ion Batteries for Electromobility: With and Without nanomaterials

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The lithium ion technology is playing a key role in the electrification of the propulsion system in hybrid electric vehicles (HEVs) and in pure electric vehicles (EVs). The chemist and materials scientists faces this new challenge, which derives from the demands for large-scale energy storage and conversion devices for electric propulsion purposes, by development and application of innovative battery components and concepts. Nanomaterials play a role in enhancing rate capability, but with their higher surface area are however, also promoting undesired side reactions, such as electrolyte decomposition and gas evolution.

The lithium ion battery has been introduced into the market by 1990/1991 and only by the mid 1990ies significant numbers of batteries have been produced. Within a few years lithium ion became the leading technology in the small format consumer battery market, which is connected to the commercial success of consumer electronic products. Small lithium ion batteries are used world-wide in almost all notebooks, cell phones and camcorders.

Beside high energy and power density, the automotive industry expects from these batteries also low cost, high safety and long life.

Presently, a 1000 kg car with a 100 kg battery can reach a driving distance of more than 70 km. It is estimated, that future batteries will eventually offer more than 300 km driving distance. To accomplish this, battery materials providing higher energies are inevitably necessary.

Similar to a modular design principle, the advantage of the lithium ion technology is, that various materials that match best with the demands defined by the application can be combined. Hence, evolutionary technology progress is possible. This „energy up – size down“- concept by new material design is a major reason for the interest in lithium ion batteries for automotive purposes. On the other hand, the incorporation of higher and higher energy contents into smaller and smaller volumes inevitably causes also safety concerns and may considerably affect the life-time. Rational compromises have to be made. Materials as core of the battery get specific attention.