



# Special Feature: Design of High-power Lithium-ion Batteries with Long Operational Life

## Overview

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The requirements for secondary batteries include (1) high energy density, (2) high power density, (3) high charging speed, (4) long life, (5) safety, and (6) low cost. When designing and developing batteries, these requirements must be suitably balanced based on the target application. For batteries for portable devices, it is important to increase the energy density since this is directly related to the usage time for the devices. Vehicle batteries should have an even longer lifetime than those for portable devices, in addition to having a high power density and a high energy density. The particular focus of our research has been increasing the lifetime and power of lithium-ion batteries.

Battery performance is strongly affected by the electrical capacity and operating voltage of the active electrode material, as well as its stability during battery operation. Further, in order to lower the resistance of a battery, that is, to improve its power density, in addition to selecting an appropriate active electrode material, it is also very important to optimize the electrode configuration. To these ends, in the battery research and development processes, combining analysis and measurement techniques with simulation techniques is crucial.

In this special issue, Paper 2 describes the electrochemical properties and stability of  $\text{LiNiO}_2$ -based active materials for lithium-ion batteries. In Papers 3 and 4, the design of electrodes for lowering the battery resistance is described. Papers 5 and 6 deal with new analytical approaches based on techniques such as X-ray diffraction, and some results obtained using these methods are presented. Finally, Paper 7 describes simulations of nano- and micro-scale Li diffusion inside a battery.

We will continue to meet the challenge of creating new ideas for developing higher performance batteries in the future.