

Battery research

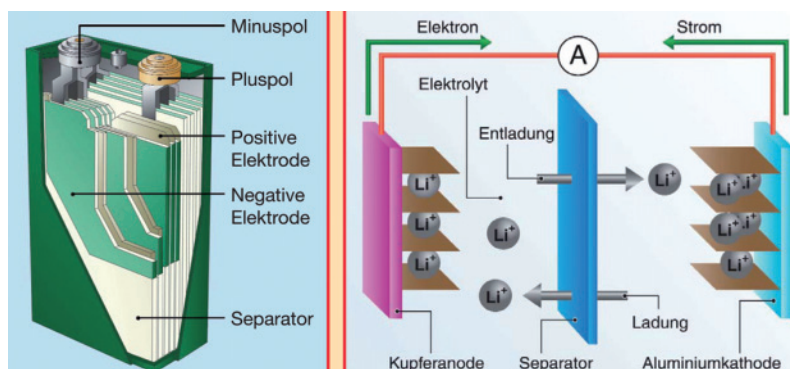


- Electrochemical characterization of batteries
- Determination of water content
- Determination of anions and cations by ion chromatography

Analytical instrumentation for battery research

Considerable resources are currently being channeled into battery research. The focus is on finding new materials enabling better energy and power density as well as more efficient energy storage.

Progress in battery research requires sophisticated instrumentation for the production and characterization of materials and cells. Metrohm provides you with top-quality analytical instruments, know-how and first-class, on-the-spot service.



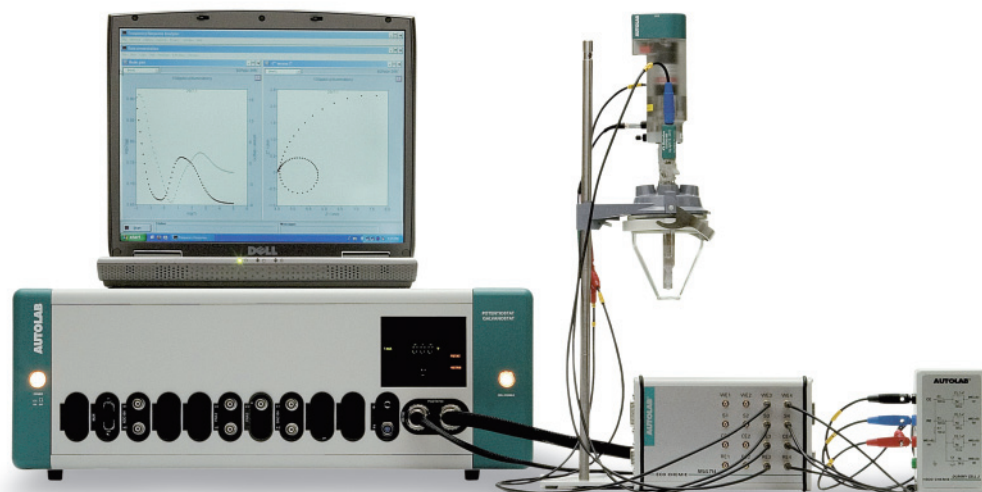
Electrochemical characterization of batteries, electrode materials and electrolytes

The total power output of a battery is determined by the properties of the electrolytes used and of the anode and cathode materials. Electrochemical methods are suitable for, e.g.:

- determining current/voltage characteristics
- tests for polarity reversal (charging) of batteries
- characterizing aging effects using impedance spectroscopy
- recording discharge and charge cycles
- determining battery capacity
- measuring the electrolyte resistance and charge transfer resistance (electrode reaction)
- determining pulse power rating/high-current capability

Metrohm Autolab instruments are ideal for the characterization and development of battery materials:

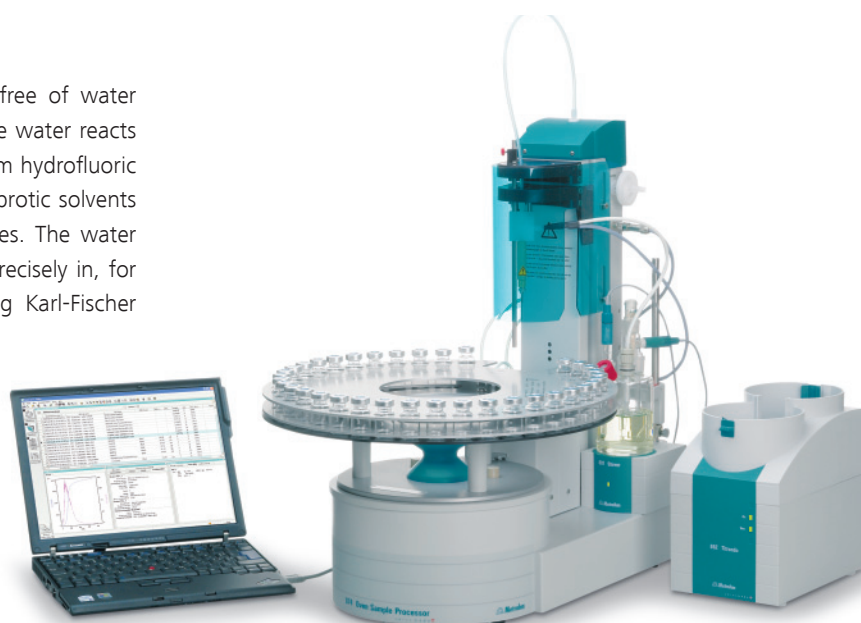
- anode and cathode materials
- separators, electrolytes, boundary layers
- determination of iron(II) and iron(III) in lithium iron phosphate



Determination of water content

Lithium-ion battery must be completely free of water (concentration of $H_2O < 20$ ppm), because water reacts with the conducting salt, e.g. $LiPF_6$, to form hydrofluoric acid. In general, mixtures of anhydrous, aprotic solvents and lithium salts are chosen as electrolytes. The water content can be determined reliably and precisely in, for example, the samples listed below, using Karl-Fischer coulometry and the oven method:

- raw materials for the manufacture of lithium-ion batteries
- electrode coating preparations (slurry) for anode and cathode coating
- the coated anode and cathode foils as well as in separator foils and in packed foil layers
- electrolytes for lithium-ion batteries



Reliable water determination with the 851 Titrando coulometer and 874 USB Oven Sample Processor

The oven method enables reliable determination of the water content of insoluble samples.

Determination of anions and cations

In the development and optimization of lithium-ion batteries, one of the items of special interest is the content of ions such as lithium, fluoride and hexafluorophosphate in the electrolyte or in eluates of different components.

Using ion chromatography, it is possible to determine various inorganic and organic anions and cations in parallel over a wide concentration range. Any sample preparation steps that might be required (elution, dilution, filtration) can be automated with the Metrohm Inline Sample Preparation («MISP») techniques. The following anions and cations can be determined:

- fluoride, hexafluorophosphate, tetrafluoroborate and lithium in eluates of individual components such as anodes, cathodes and separator foils
- fluoride, hexafluorophosphate and lithium in electrolyte liquids



850 Professional IC plus 858 Professional Sample Processor:

Metrohm offers a unique range of completely automated sample preparation techniques for ion chromatography.

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