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Solutions for battery research

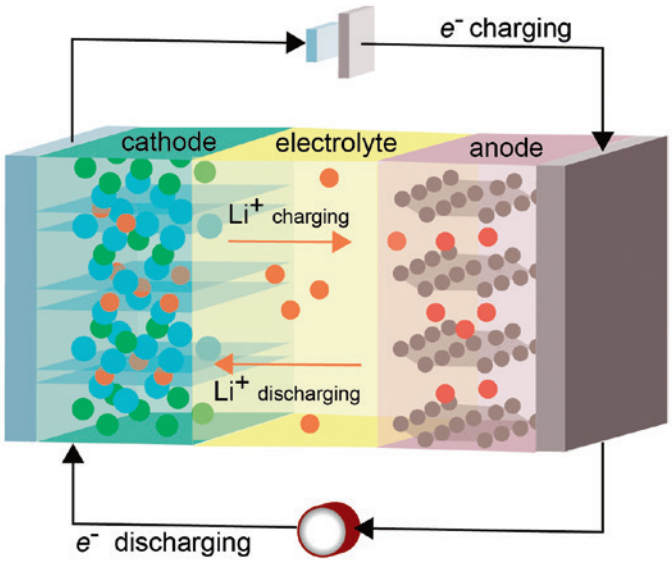
PANalytical - your best partner

Overview

As the energy transition from fossil fuel to more sustainable sources becomes important, the need for large-scale electrochemical energy storage arises. Currently Li-ion batteries are present in any portable electronics device and in electrical vehicles. While Li provides a large part of the currently available electrode materials, the availability of Li on Earth remains small and thus alternative elements such as Na or Mg are being considered to replace Li. Development of low- cost electrode materials using alternative elements is quickly becoming a topic of high interest in the scientific community.

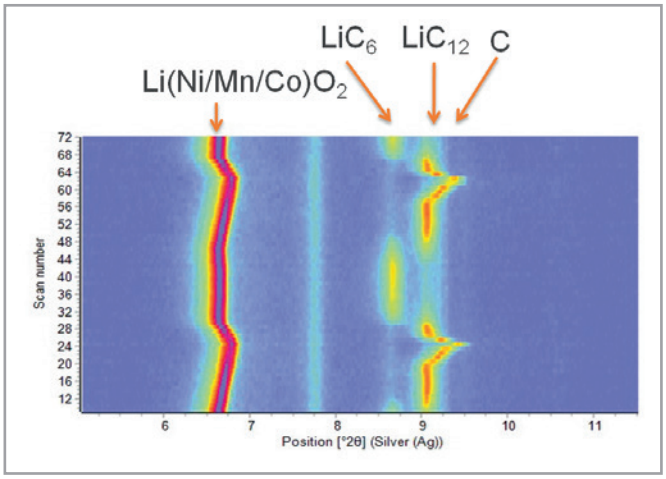
Empyrean

Using in-depth structural analysis made possible by the Empyrean diffractometer, one can unravel the nature of phenomena specific to the battery research, leading to a better understanding of electrochemical mechanism, and ultimately to an improved battery design.



Phase changes during charge/ discharge: *in operando* study

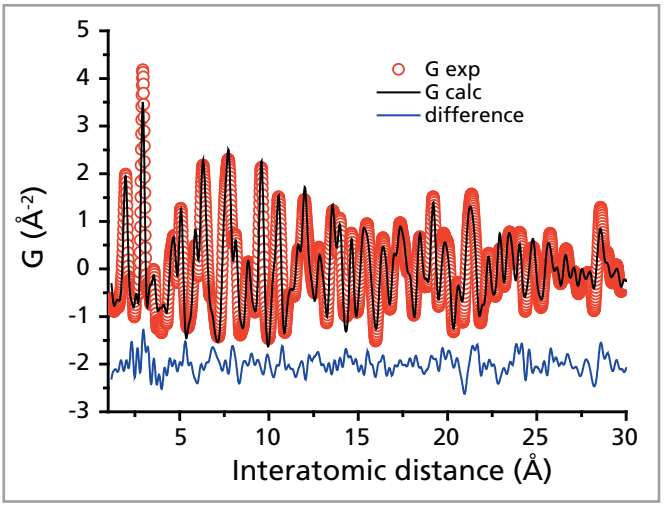
Charging/discharging cycle of a LNMC commercial prismatic battery cell measured using Ag radiation, showing phase changes in the anode and cathode



In operando *measurement of a commercially available prismatic cell*

Local structure and short-range order: pair distribution function analysis

Local order of Na in the pristine layered $Na_{2/3}[Mn_{1/2}Fe_{1/2}]O_2$ electrode investigated using Ag radiation



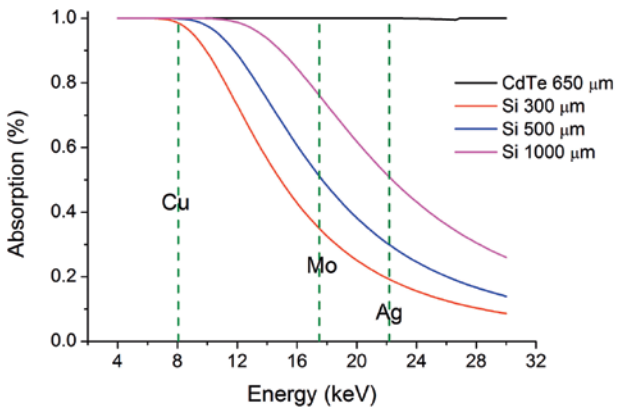
Pair distribution function measurement of material electrode using Ag radiation (data taken from E. Talaie et al., ***Energy Environ. Sci.***, 2015,**8**, 2512-2523)

Whether you are interested in electrode material characterization, *in operando* experiments or investigation of the local structure, PANalytical is your ideal partner to design the solution that you need.

GaliPIX3D

The most efficient detector for hard radiation available on the market

- **CdTe sensor**
- **60 µm pixel size**
- **501 x 465 pixels**



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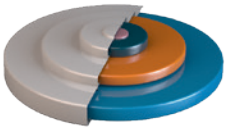
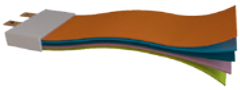
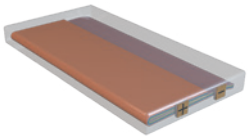
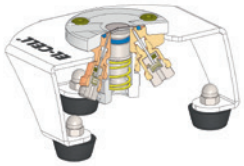
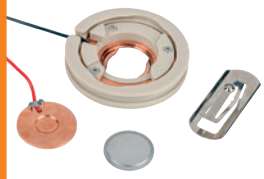
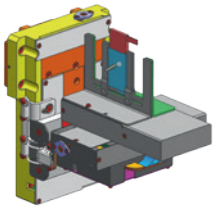
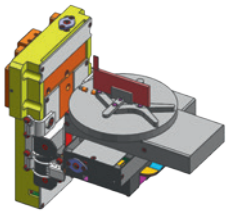
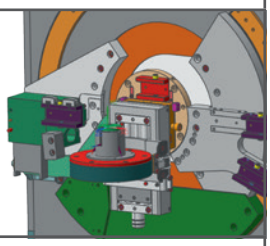
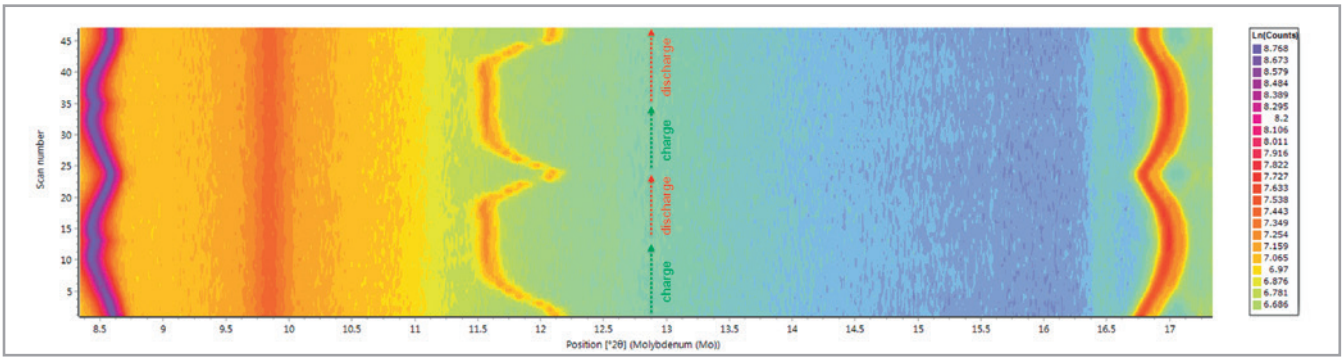
Overview of sample types and solutions

	Coin cell	Pouch cell	Prismatic cells	Electrochemical stages
Schemes				
PANalytical solutions				
Radiation	Cu, Mo	Mo, Ag	Ag (Mo)	Cu, Mo
Geometry	Reflection	Transmission	Transmission	Reflection
Sample stage	R-T spinner and other stages with clamping device	Modular x,y,z multipurpose sample stage	Modular x,y,z multipurpose sample stage	Modular x,y,z multipurpose sample stage
Sample size	Available for 20 mm diameter. Other sizes on request	No standardized battery cell size exists. Concept can fit large variety of sizes	No standardized dimensions. Maximum thickness ~4-5 mm	Maximum size working electrode ~10 mm



Variation in the XRPD data during two full charge and discharge cycles. The peaks at about 8.5° and 17° 2theta belong to the LiNMC phase, (003) and (101) reflections respectively. The peak at about 12° 2theta is the (002) reflection of graphite.

For further reading download the Application Note "High-quality *in operando* X-ray diffraction analysis of pouch bag lithium-ion batteries"

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About PANalytical

PANalytical's mission is to enable people to get valuable insight into their materials and processes. Our customers can be found in virtually every industry segment, from building materials to pharmaceuticals and from metals and mining to nanomaterials. The combination of our software and instrumentation, based on X-ray diffraction (XRD), X-ray fluorescence (XRF) and near-infrared (NIR) spectroscopy as well as pulsed fast thermal neutron activation (PFTNA), provides our customers with highly reliable and robust elemental and structural information on their materials and is applied in scientific research and industrial process and quality control.

PANalytical employs over 1,000 people worldwide. The company's headquarters are in Almelo, the Netherlands. Fully equipped application laboratories are established in Japan, China, the US, Brazil, and the Netherlands. Supply and competence centers are located on two sites in the Netherlands: Almelo (X-ray instruments) and Eindhoven (X-ray tubes), in Nottingham, UK (XRF applications and standards), in Quebec, Canada (fusion sample preparation) and in Boulder CO, US (near-infrared instruments). A dedicated research activity is located on the campus of the University of Sussex in Brighton (UK).

PANalytical is active in all but a few countries of the world with a worldwide sales and service network that ensures unrivalled levels of customer support.

The company is certified in accordance with ISO 9001 and ISO 14001.

Visit www.panalytical.com for more information about our activities.

PANalytical is part of Spectris plc, the productivity-enhancing instrumentation and controls company.

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With the largest service network we are able to offer the most comprehensive support package possible.

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- Training courses
- Performance optimization
- Customizable expertise programs
- Assistance with multi-laboratory standardization

Care Agreements

Our customer support solutions have been developed with your business in mind. They are formulated as a family of four Care Agreements which can be tailored to your specific needs and provide fast, secure and reliable support.

- **ECONOMY: indispensable coverage for self-sufficient operations**
- **ADVANCED: cost-effective support for routine usage**
- **PREMIUM: flexible package for high equipment usage**
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