

Analysis of Electrode Surfaces by IR Laser Imaging

Application Note M176

The electrodes: a key factor in battery development

The world requires ever more efficient energy storage, be it for electromobility, households, or portable devices. For all these applications, the electrodes of a battery play a crucial role, as their quality has a direct impact on storage efficiency and lifetime. For the successful development of new and improved energy storage systems, it is essential to find the ideal electrode composition and to ensure perfect homogeneity in the distribution of the components inside the electrode.

How IR laser imaging supports research

Infrared microscopy is an established tool for the development, testing and quality control of these new materials. However, sample analysis can be very time consuming. Hence, methods such as IR Laser Imaging are in great demand as they significantly increase sample throughput in chemical analysis. This drastically reduces the development time of new products and also enables comprehensive quality control during production.

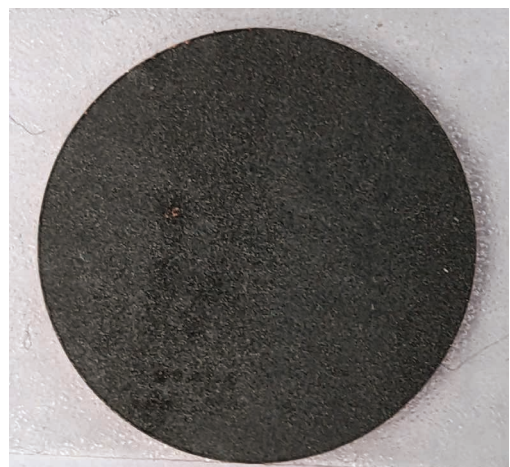
The speed advantage of IR Laser Imaging comes from combining a high power IR source with a large field imaging detector. This enables non-contact measurements of large sample regions where previously use of the ATR technique was required and therefore analysis restricted to small areas. In addition, it is possible to focus on individual wavenumbers rather than entire spectra, further increasing the speed advantage for routine analytical tasks.

In this document, we use the HYPERION II-ILIM, which offers IR laser imaging using quantum cascade lasers (QCL) as well as a classical FT-IR detector with a global source.

Fast, non-contact surface analysis for determination of polymer distribution

To demonstrate the power of this technique, we analyzed an Anode surface of a Lithium Iron Phosphate (LFP) battery. The analytical task was to investigate the distribution homogeneity of the polymer used to bind the graphite material to the metal carrier.

Fig. 1
Anode surface consisting of graphite, active carbon and PVDF as a binding polymer.



The anode surface has a diameter of 15 mm and was measured with only two wavenumbers to create a difference image to highlight the distribution of the binding polymer (fig.1). The measurement was performed with 5 µm pixel size and took only 2.5 minutes.

The resulting chemical image shows an almost uniform blue color. The distribution of the polymer can thus be regarded as largely homogeneous, with isolated hotspots indicated by a few (white) bright spots.

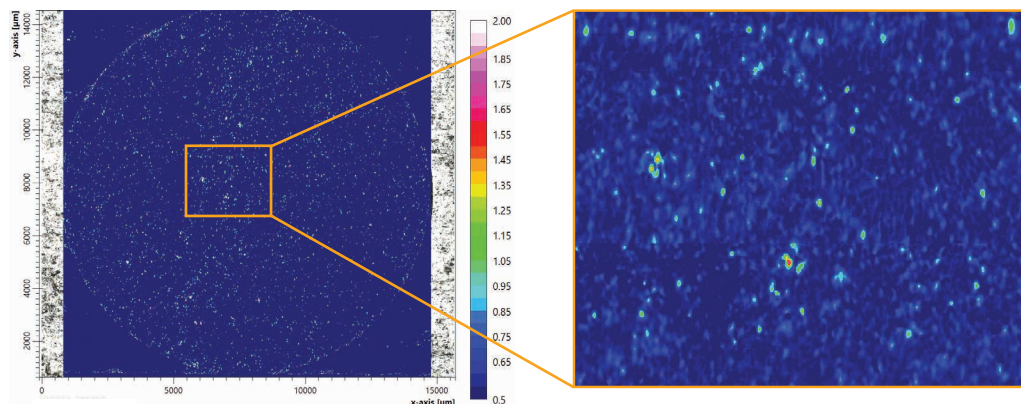


Fig. 2
Chemical image of the polymer distribution on the Anode surface. Bright highlights indicate inhomogeneities

Faster development and response times by IR laser imaging

In less than three minutes, the result shows that changes in the manufacturing process are necessary to increase the homogeneity and thus the quality of the product. The rapid availability of chemical information enables quick adjustments in the event of quality deviations or optimization of the process during research and development.

HYPERION II – IR Laser Imaging Microscope

The HYPERION II is Bruker's versatile IR microscope aimed at high-end research and development. It is highly flexible and can be equipped with different detectors to cover a spectral range from FIR to NIR & UV/Vis. Even complex tasks such as time-resolved experiments and emission measurements are readily performed, delivering valuable insight into a reaction or a sample.

With the introduction of IR Laser Imaging the HYPERION II allows for new applications such as the contactless imaging of electrodes. The ability to focus on individual wavenumbers instead of full spectra even further increases the speed of analysis. In other words, the HYPERION II is the ideal choice for high-throughput measurements or the imaging of large areas.

