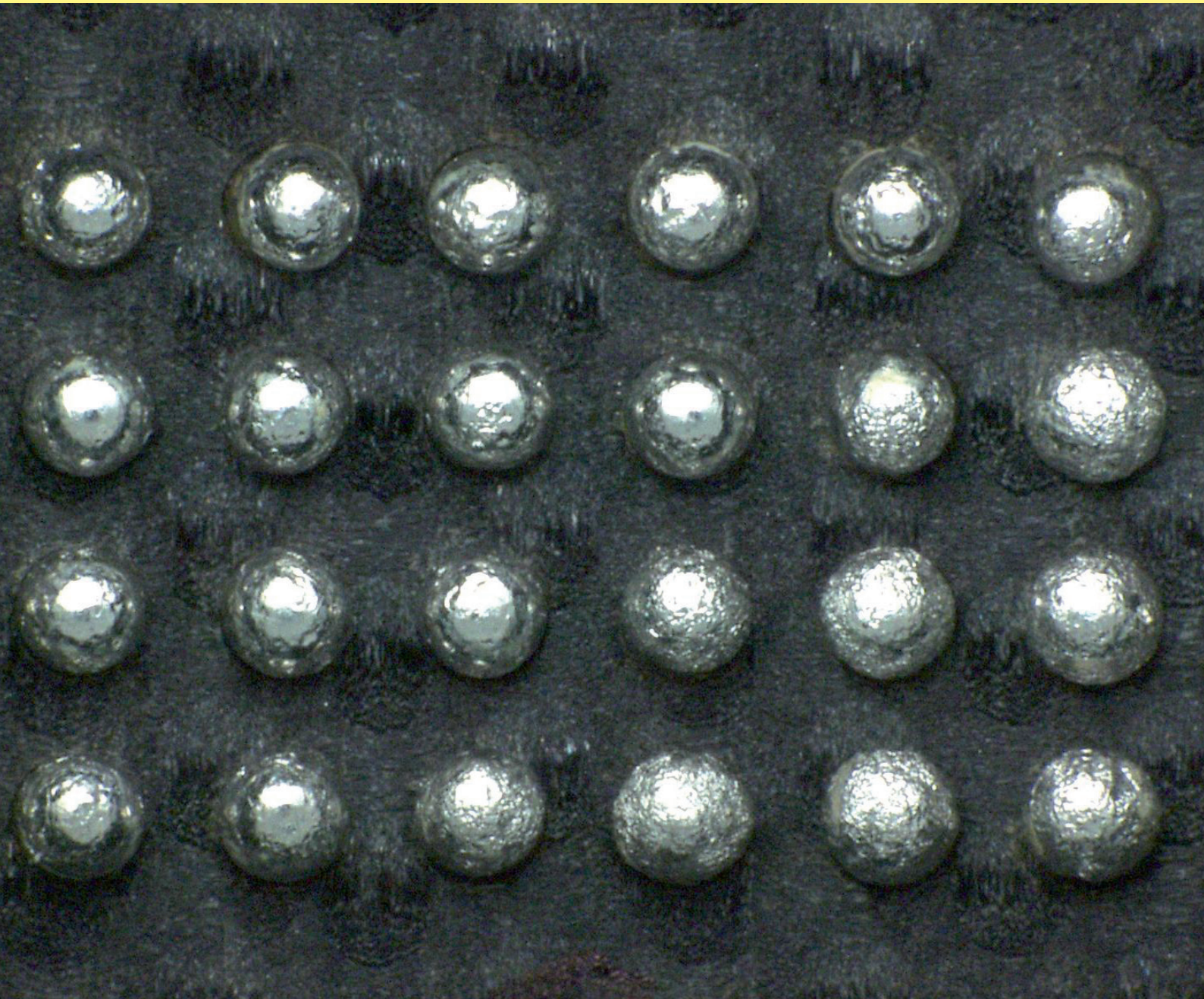
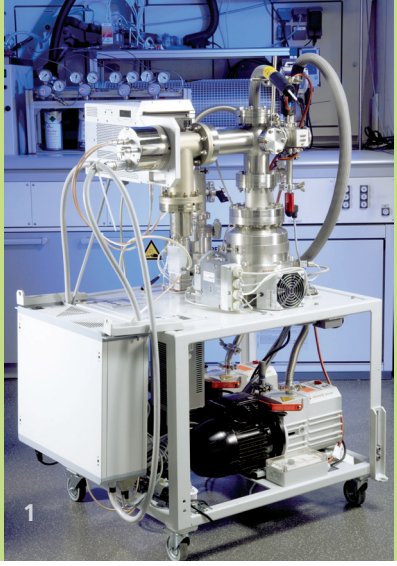
Fraunhofer
ICT

FRAUNHOFER INSTITUTE FOR CHEMICAL TECHNOLOGY ICT

ANALYTICS IN APPLIED ELECTROCHEMISTRY





1

The Applied Electrochemistry Department at the Fraunhofer Institute for Chemical Technology ICT has been working on analytics in the electrochemistry field for several years, and has extensive facilities and equipment for electrochemical analysis. Electrochemical approaches must often be used in conjunction with classical analytical methods.

Corrosion tests

Undesired corrosion effects in batteries and many types of component parts can be investigated using electrochemical measurement methods. X-ray spectroscopy can be used to identify the elemental composition of corrosion products.

Measuring leakage

In various industrial sectors the identification of highly volatile compounds released from liquid mixtures, polymeric materials, batteries, fuel cells or electronic components plays a significant role. For example, the Fraunhofer ICT carries out density measurements on batteries in a vacuum (10^{-3} mbar to 10^{-7} mbar). Gases released from the electrolyte are subsequently identified. Self-discharge reactions can be identified through an analysis of all the gases in the battery. Technical components can be tested for leakage using helium, and the Fraunhofer ICT performs these tests according to the EU standard DIN EN 60068-2-17 using online mass spectroscopy (online-MS). With this method, very small leakage rates of < $1\text{-}10^{-8}$ mbar l/sec can be measured.

Real-time monitoring of hydrogen

Another area of activity is the monitoring of hydrogen from fuel cells in real-time, using mass spectrometry based on electron-impact ionisation. Measurements take less than 100 ms, with a time resolution in the order of microseconds. Quantities from the lower ppb to the high percentage range can be detected. These analysis methods are used, for example, in the evaluation and testing of sensors, and in particular the testing of conventional hydrogen sensors.

Imaging and surface analysis

In order to analyse the surface properties of fuel cells and battery materials, and investigate surface-specific phenomena such as corrosion, the Department of Applied Electrochemistry uses a variety of methods to prepare and characterise the materials. These include: digital microscopy, Raman microscopy, scanning electron microscopy, atomic force microscopy and scanning-tunnel electron microscopy. The availability of these different analysis methods in one location means that they can be combined in a flexible way, and allows a rapid exchange of information.

COVER PHOTO:

BGA solder balls.

1 *High-resolution, high-speed mass spectrometer.*

2 *Gas production unit.*

3 *GC sulphur analysis.*

Membrane characterisation and differential electrochemical mass spectrometry

Connecting a mass spectrometer to a membrane inlet allows the permeabilities of the membrane to be measured. This process can also be used to determine the diffusion coefficient of methanol and ethanol in ion-exchange membranes with relation to temperature. Differential electrochemical mass spectrometry (DEMS) is used to investigate electrochemical reaction mechanisms.

Chromatographic analysis

Electrochemical processes are used to analyse complex material mixtures. Various chromatographic methods are also used, including gas chromatography (GC), high-performance liquid chromatography (HPLC), ion chromatography (IC) or capillary electrophoresis (CE). Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) can be used for thermal material separation.

One example is the use of these methods to quantify (down to the ppm range) the gaseous and sometimes toxic compounds released during abuse tests on batteries.

Development of analytical processes in conjunction with electrochemistry

One outstanding competence of the Fraunhofer ICT is the development of analytical processes involving electrochemical detectors and detection techniques. For example, the combination of conventional electrochemical sensors with liquid chromatography and capillary electrophoresis enables the amperometric detection of sugars. The development of new capillaries for capillary electrophoresis is a further area of activity at the institute.

Novel detection methods can be used to optimise production processes. One example is the identification of traces of sulphur compounds in a complex sample matrix (ppm range) by a highly-sensitive detector.

Further analytical methods available at the Fraunhofer ICT can be used in combination with the above techniques to optimise the service we provide.

Our offer

We offer a wide variety of analysis methods for the optimisation of products and production processes and the identification of faults. We also carry out studies tailored to our customers' needs, and help them to identify the necessary experts.

Through consultations with our experts and situational analyses at our customers' sites, we aim to provide customer-specific solutions.

ANALYTICS IN APPLIED ELECTROCHEMISTRY

Fraunhofer Institute for
Chemical Technology ICT

Joseph-von-Fraunhofer-Strasse 7
76327 Pfinztal (Berghausen),
Germany

Contact
Applied Electrochemistry

Dr. Jens Tübke
Phone +49 721 4640-343
Fax +49 721 4640-318
jens.tuebke@ict.fraunhofer.de

Peter Rabenecker
Phone +49 721 4640-247
Fax +49 721 4640-318
peter.rabenecker@ict.fraunhofer.de

www.ict.fraunhofer.de

V01.0_en