enovasense
BEHIND THE INVISIBLE

PRECITEC

THE ENOVASENSE TECHNOLOGY FOR BATTERY METROLOGY

October 24, 2023 | EPIC Meeting, Stuttgart | Geoffrey Bruno

A STARTUP TEAM WITHIN AN INTERNATIONAL GROUP

PRECITEC

EMPLOYEES / ORGANIZATION
A team of 15 engineers around Jean Inard-Charvin and Geoffrey Bruno, founders

SENSORS
Hundreds of sensors installed in the world for 10 years of cutting-edge development

PATENTS
1 international patent filed
1 international patent co-filed with the Renault Group

A FAST GROWING GROUP
15% yearly growth on turnover

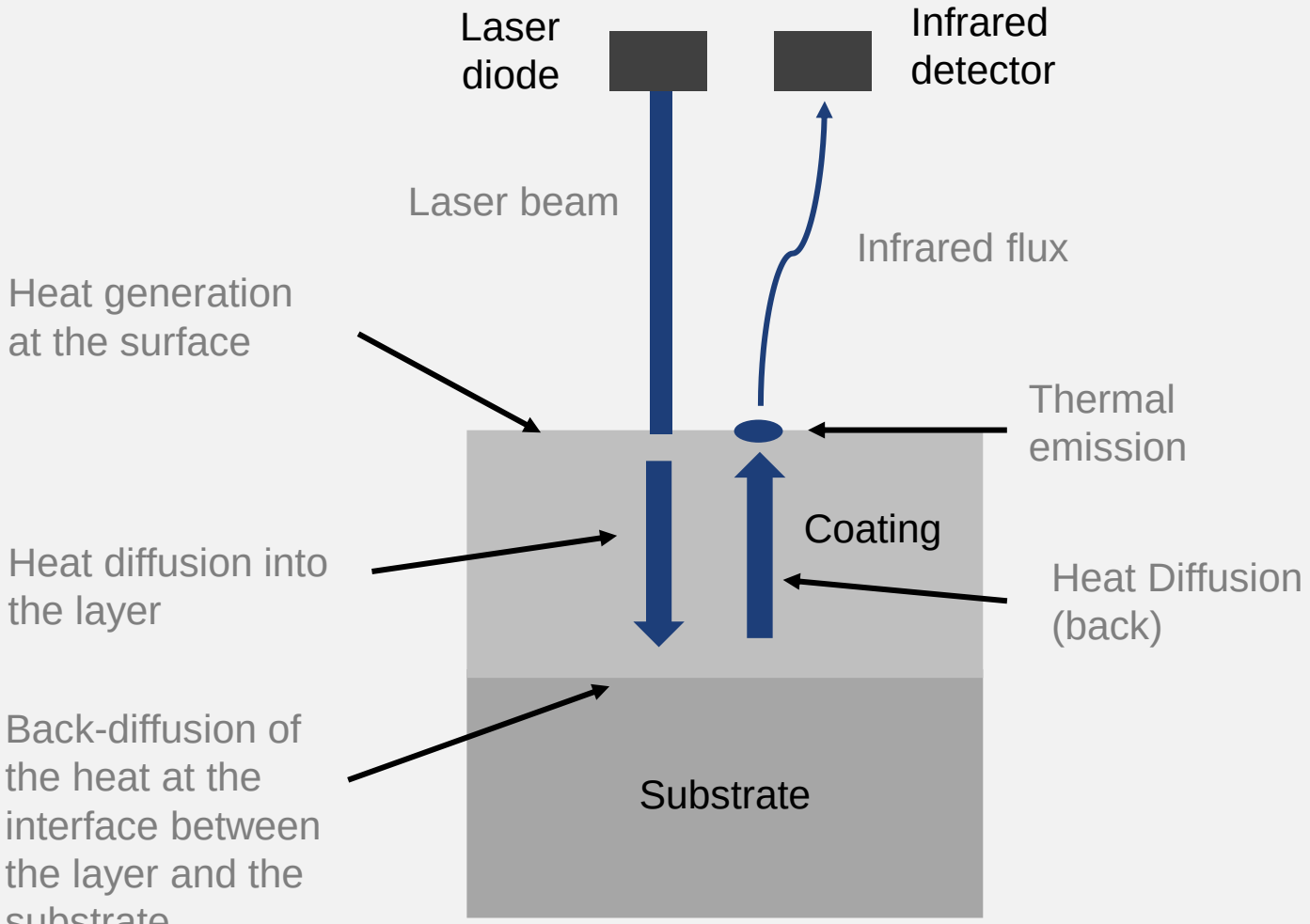
A HIGHLY INNOVATIVE GROUP
14% R&D invest p.a. as percentage of turnover
245 Patents | 13 Innovations

EMPLOYEE GROWTH/SATISFACTION
- 774 Employees | 28 Nationalities
- 52% employed by the company for more than 5 years
- 30 % employed more than 10 years

AN INNOVATIVE SENSOR FOR COATINGS METROLOGY

A patented unique technology
Laser PhotoThermal Radiometry

The sensor head emits a **laser beam** and includes an **infrared detector**



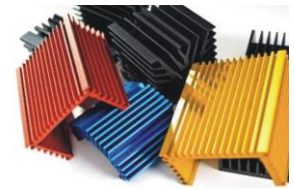
The delay introduced by the heat flux propagation is linked to the **thickness** and the **physical properties** of the coating and the substrate.

A LARGE RANGE OF MEASURABLE MATERIALS

FROM COATING MATERIALS…

PAINTS
Wet or dry
Uncured or polymerized
Powder or solvent-based

METALLIC COATINGS
Electrodeposited
Thermally sprayed
PVD-CVD coated



SURFACE TREATMENTS
Anodizing
Heat treatments

POLYMERIC AND ORGANIC COATINGS
PTFE
Carbon layers
Rubber

CERAMIC COATINGS
Thermal barriers
Biocompatible layers
Silicon carbide

INKS, VARNISHES, ENAMELS, RESINS, ADHESIVES…

TO SUBSTRATE MATERIALS…

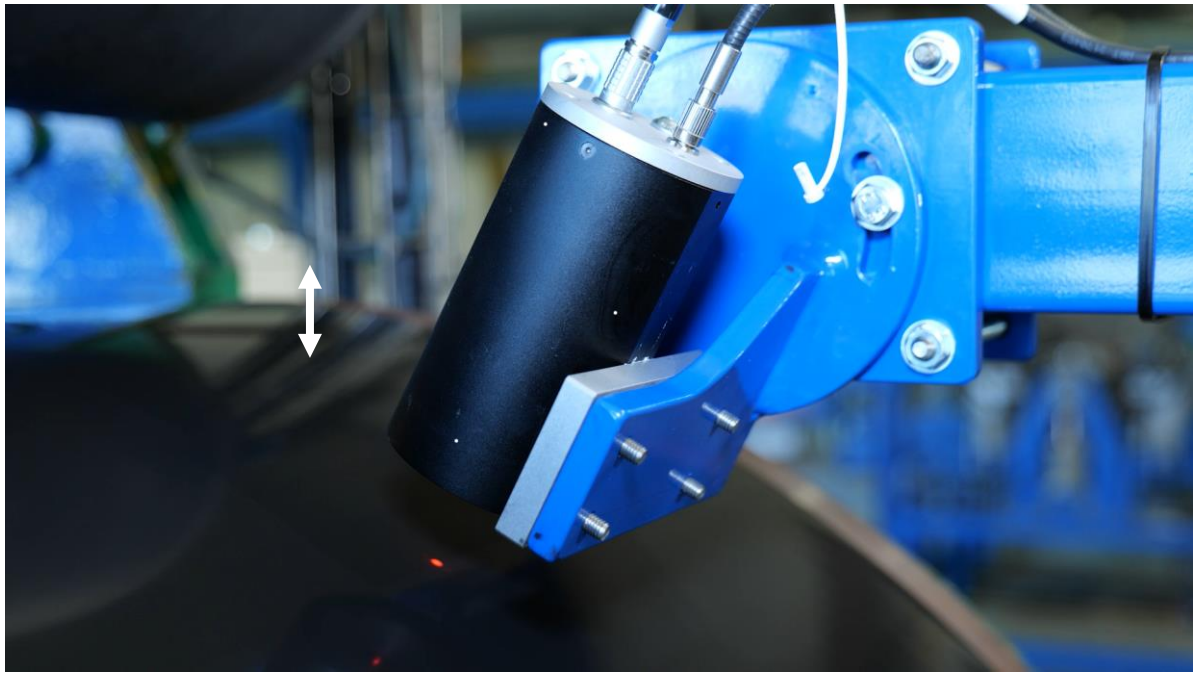
METALS
PLASTICS
WOOD
GLASS
COMPOSITES
CERAMICS
…

As long as the material can be heated by the laser, the sensor gets a response from the material. Contrary to other technologies, there is no material limitation for the diffusion of the thermal wave inside the coating.

This means that this technology can measure on applications where no other non destructive technology can measure, like for paint on composite or ink on glass.

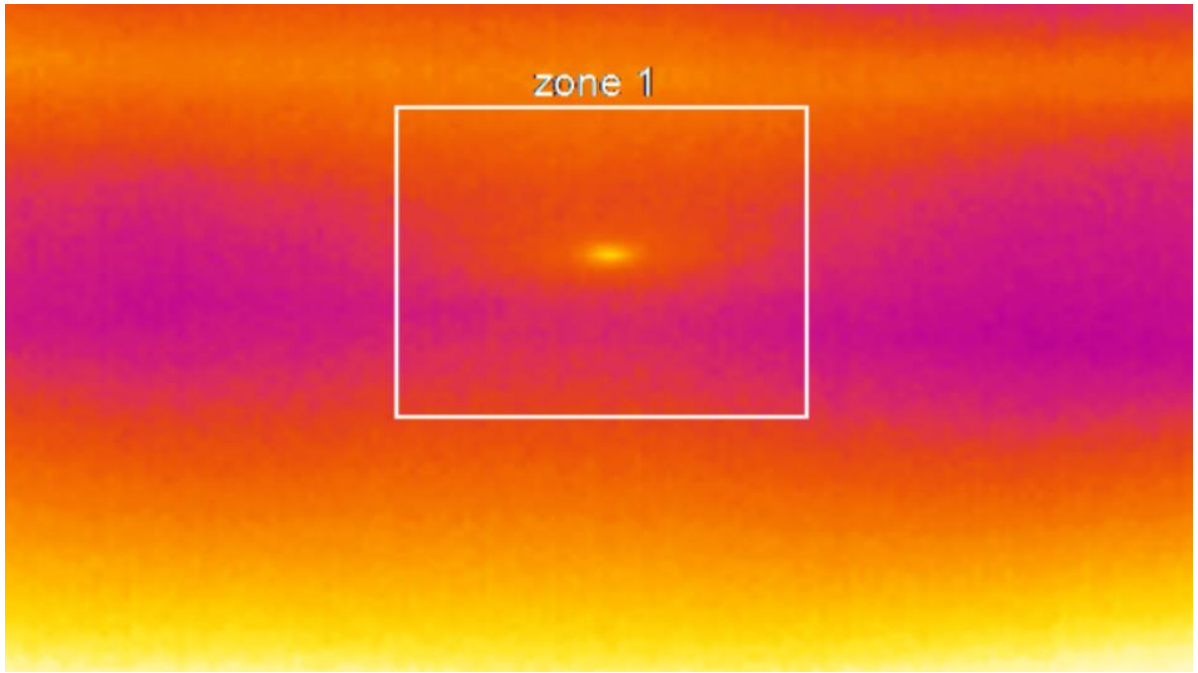
A TECHNOLOGY FITTED FOR IN-SITU INTEGRATION

NON CONTACT



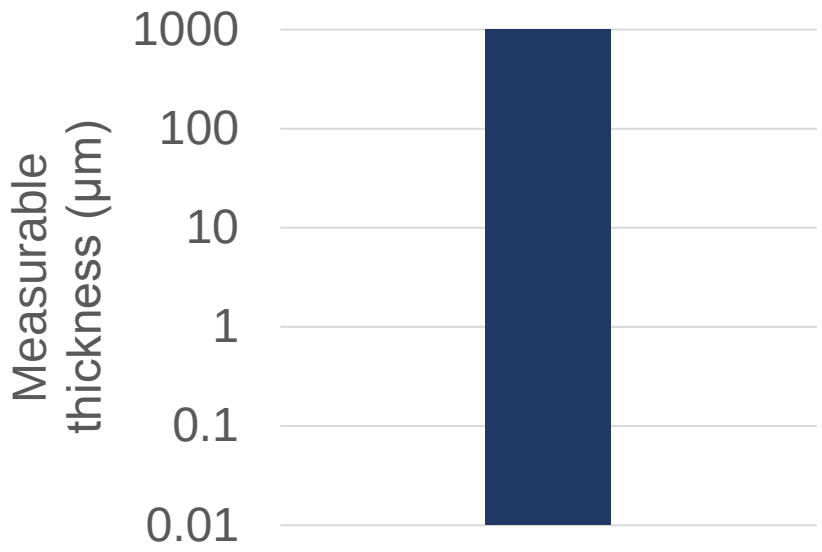
The sensor head is placed at 20mm or 40mm of the part to measure : no contact is needed.

NON DESTRUCTIVE



The typical heat increase generated on the part by the laser beam is lower than 5°C. This does not harm or alter the coating.

A TECHNOLOGY FITTED FOR IN-SITU INTEGRATION



Measured thickness	Typical RMS precision
1 mm	5-30 µm
100 µm	0.5-3 µm
10 µm	0.05-0.3 µm
1 µm	5-30 nm
100nm	0.5-3 nm

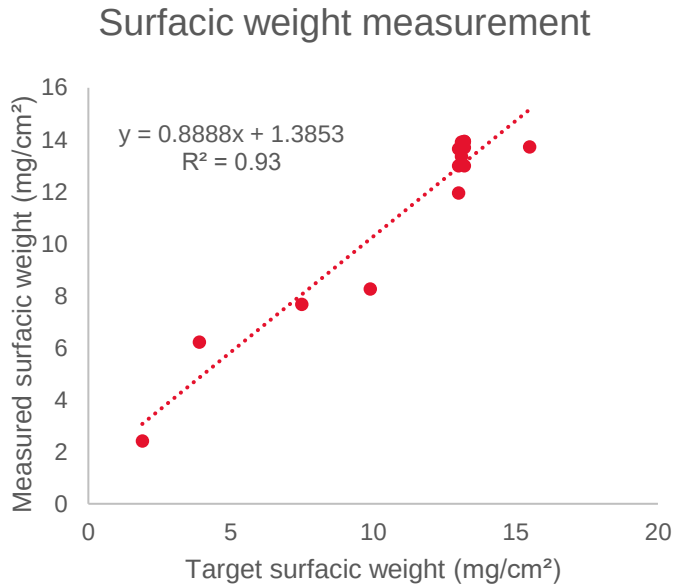
HIGH THICKNESS RANGE

The measurable coating thickness ranges from 10nm up to 1mm.
Depending on the coating material, the maximum measurable depth can go from 200µm to 1mm

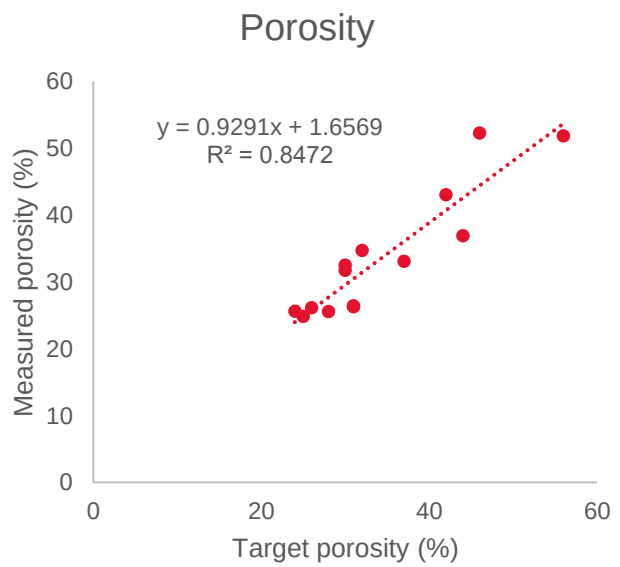
HIGH MEASUREMENT PRECISION

The repeatability and accuracy in intercomparison RMS error ranges typically between 0.5 and 3% of the measured thickness.
In the best case met, the repeatability reached 20nm for a 3µm thick layer.

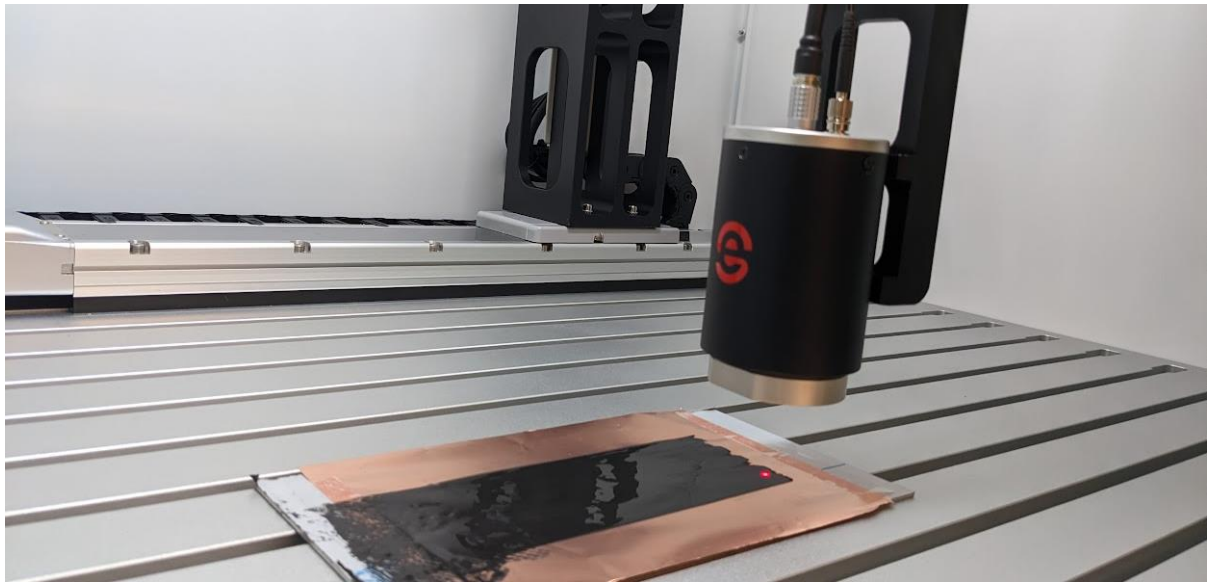
ELECTRODE MEASUREMENT BEFORE CALENDERING

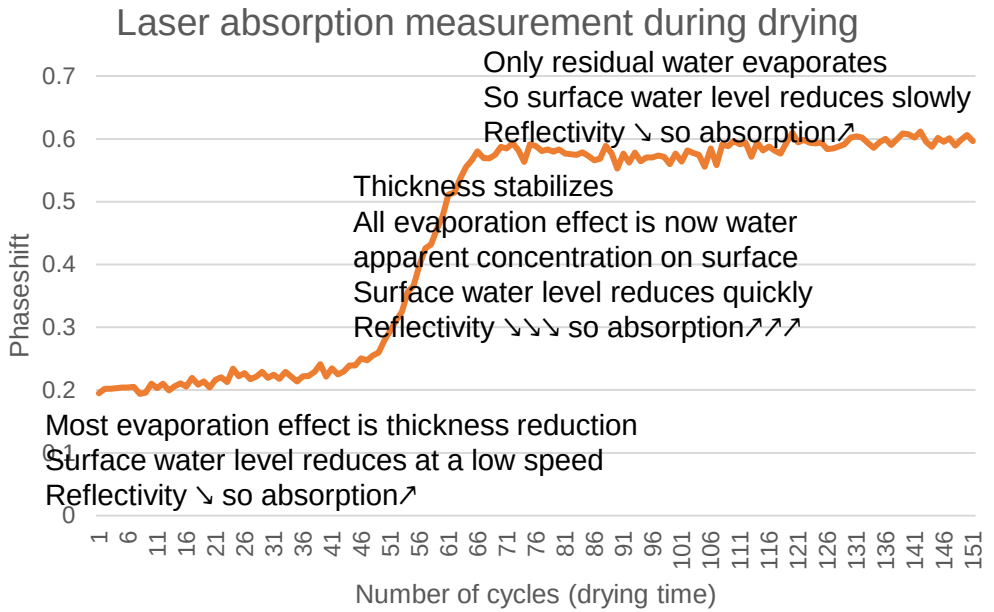


- Before calendering, the sensor can measure the coated electrode foil surfacic weight and porosity.
- The measurement is performed by a single-sided sensor with no need for prior measurement before coating.
- The measurement technology is non radiative and the laser source has decades-long lifetime with no shift in time.



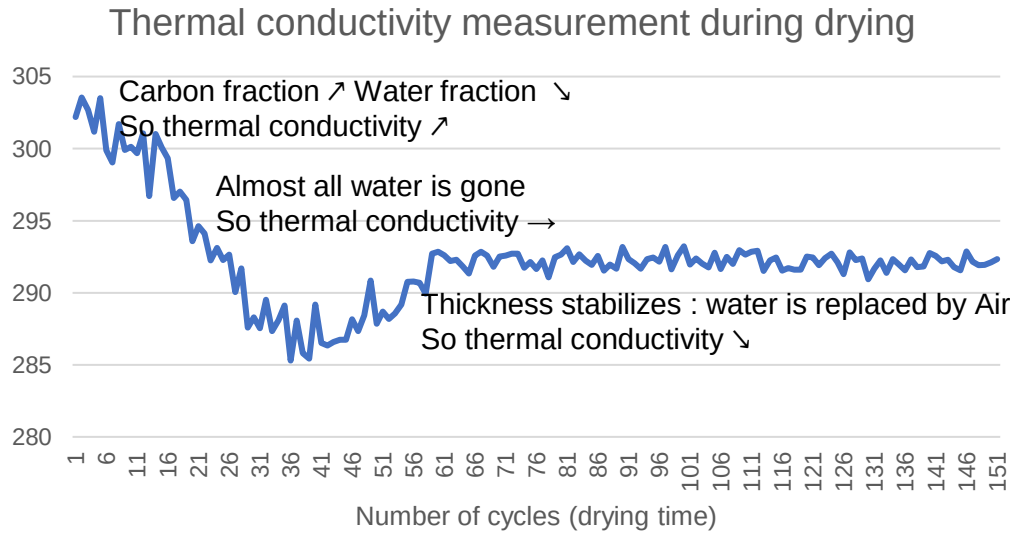
ELECTRODE DRYING PROCESS CONTROL





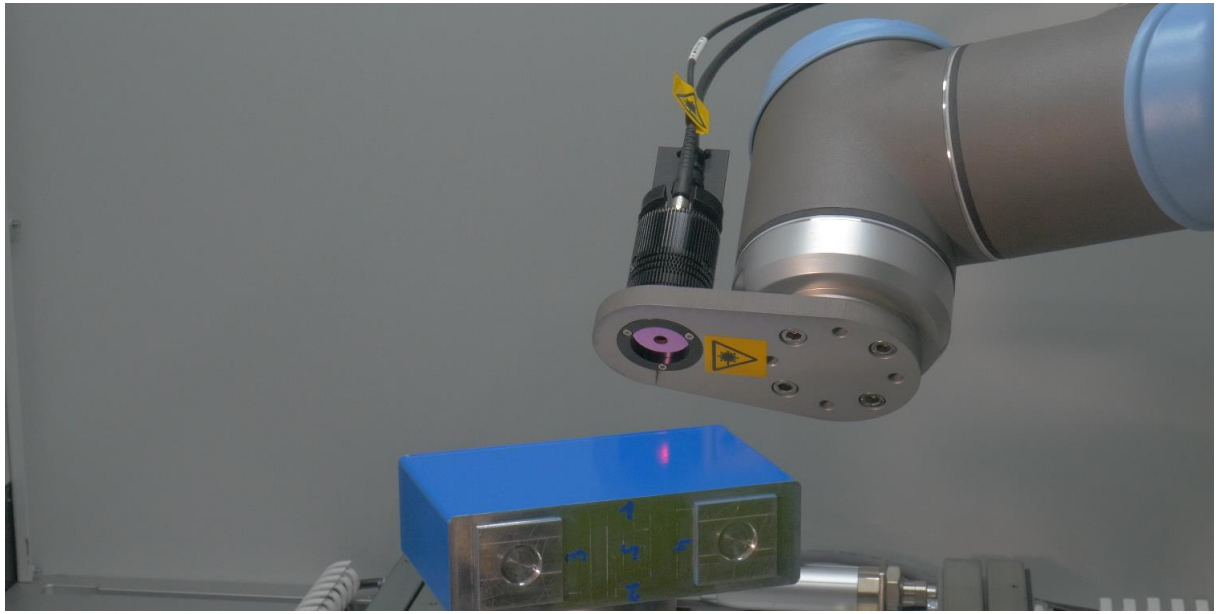
- The drying process of coated electrodes is key to increase the speed and production volume of battery lines.

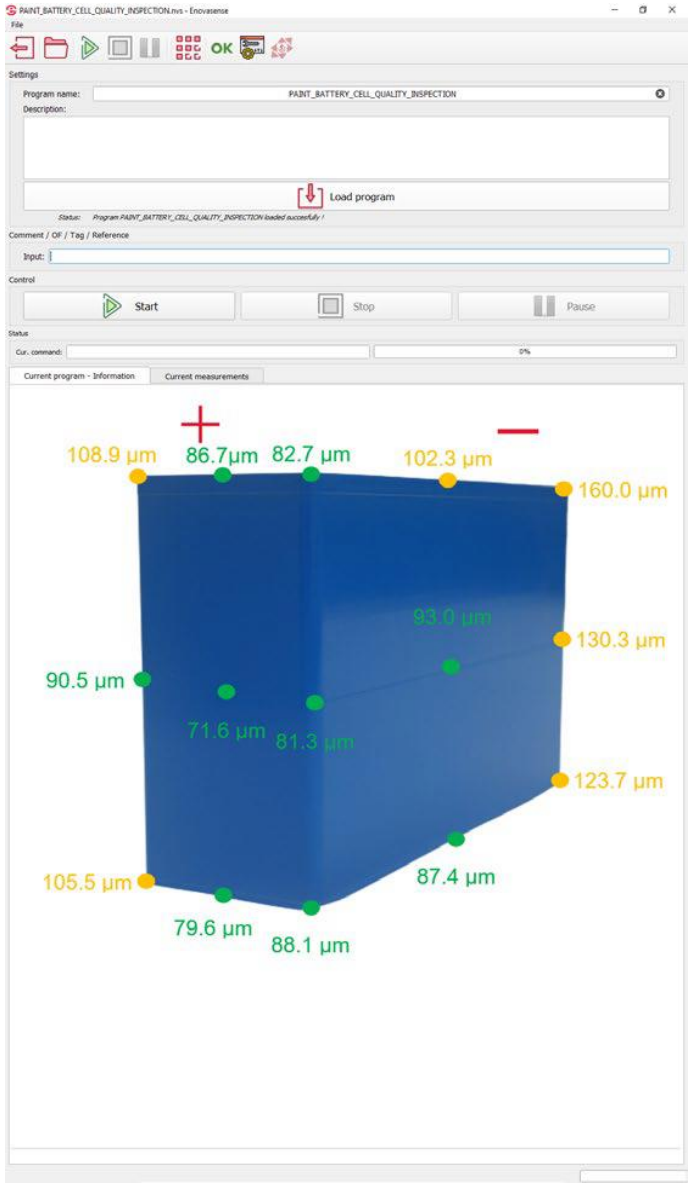
- The laser photothermal technology allows to access to key parameters such as absorption or thermal conductivity, directly linked to the 3-step drying process



Karlsruher Institut für Technologie

BATTERY CELL DIELECTRIC PAINT MEASUREMENT





- The dielectric insulant paint applied on battery cells must be controlled for thickness at all critical positions around the battery.
- Repeatability levels as low as 0.3 µm can be obtained on a typical 100 µm thick layer.
- Similar paints can also be measured on hairpins and battery cooling plates.

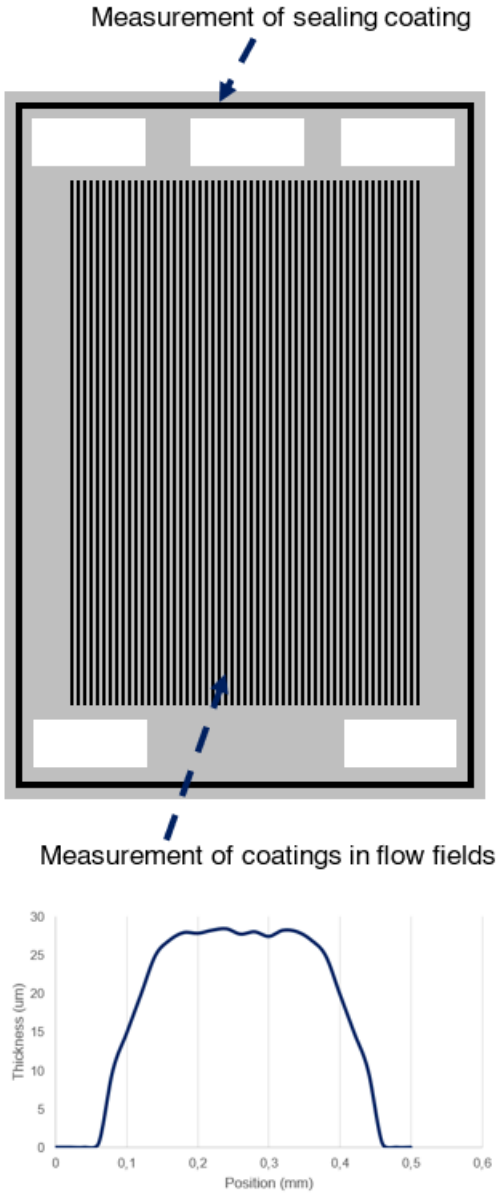
FUEL CELL BIPOLAR PLATES MEASUREMENTS

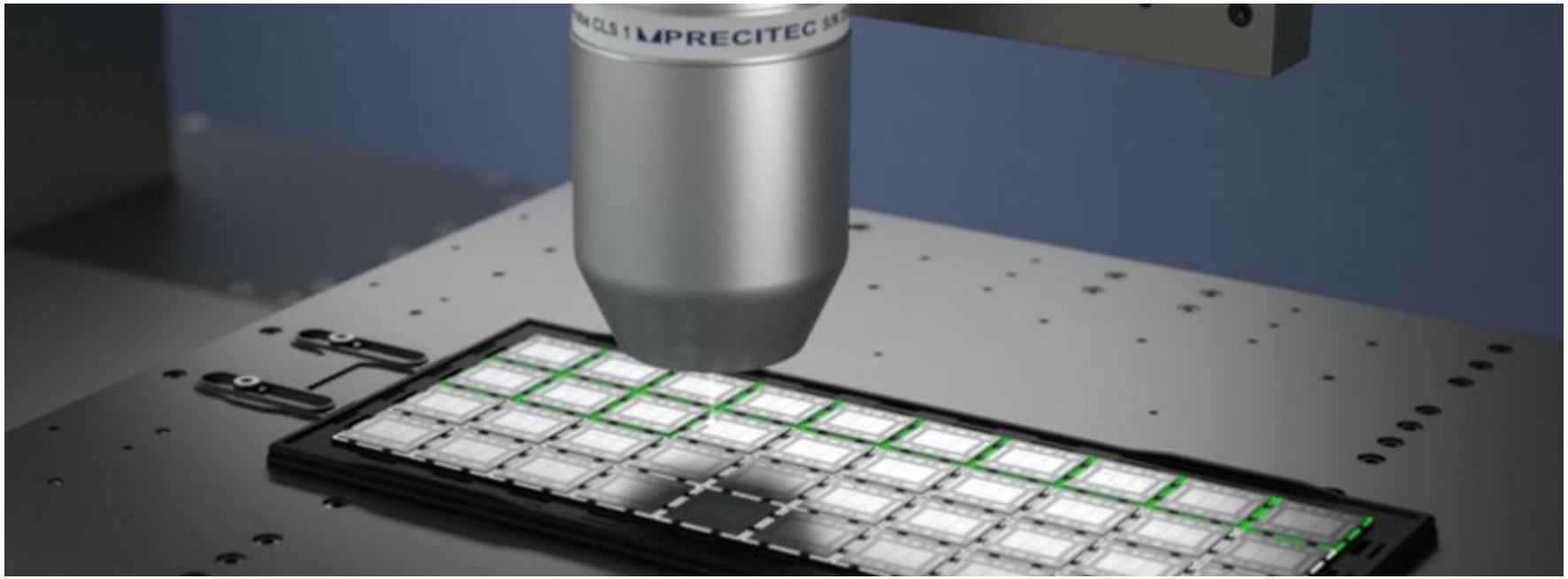
Fuel cell and electrolyzers production process have many coating steps, such as coatings for :

- electrode conduction (e.g. silver or nickel),
- electrocatalyst function (e.g. platinum or carbon),
- corrosion resistance (e.g. chromium or titanium),
- sealing,
- water management,
- contact resistance reduction.

The Enovasense technology has been proven highly effective for such measurements, even on complex cases such as :

- Nanometric organic layers
- Measurement of coatings in very thin flow fields
- Nickel layers on electrolyzer bipolar plates





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