

# ELKEM TECHNOLOGY R&D CENTER

Elkem Technology R&D Center består av over 50 dedikerte ansatte med tverrfaglig kompetanse og erfaring innen metallurgiske høytemperaturprosesser og relaterte områder. Vi disponerer om lag 10 000 kvadratmeter med avanserte test- og piloteringsfasiliteter, laboratorier for kjemisk analyse og materialkarakterisering, samt verksteder. Den unike kombinasjonen av pilotanlegg og tilhørende laboratoriefasiliteter øker fleksibilitet i oppdragsløsningen og muliggjør komplette leveranser for våre kunder.



# ELKEM TECHNOLOGY PILOT

Elkem Pilot Plant is an industrial R&D center with core competence in metallurgical high temperature processes and related areas of expertise from raw materials testing and verification to material processing and process development. We offer customers and collaborating partners more than 10.000 square meters of advanced testing facilities, laboratories and workshops.

## Core competence

- Equipment testing and verification
- Material processing
- Powder technology
- Product testing
- Process development and verification
- Pyrometallurgical processes
- Waste to resources



# ELKEM TECHNOLOGY LAB

Elkem Technology lab includes advanced laboratories within materials characterisation, chemical analysis and a lab projects group. We also have a separate battery lab.

## Core competence

- Material characterisation
- Chemical analysis
- Development of analytical applications, quality control, Measurement System Analysis (MSA) and statistical validation
- Interlaboratory tests – Proficiency Testing Program (PTP)
- Battery testing facilities
- Environmental sampling (PAH analyses, emission measurement analysis)
- Powder analysis



# Netzsch ZETA 25

## Description

The Netzsch Zeta 25 is a multi-pass agitator bead mill, which allows for milling of suspension down to nanometer range.

## Related equipment

Particle measurement (Malvern Mastersizer).

Drying of suspension (Rotavapor)

## Technical specifications

- Milling volume 25 liters
- Total volume 500 liters
- Working temperature 5 – 40 °C
- Capacity of rpm, kW
- Wide viscosity range
- Grinding in nano- and micrometer range
- ATEX certified
- Inertization



# WAB Dynomill

## Description

The WAB Dynomill is an agitator bead mill, which allows for one pass and multi-pass operation down to nanometer range.

## Related equipment

Particle measurement (Malvern Mastersizer).

Drying of suspension (Rotavapor)



## Technical specifications

- Milling volume 0,6 liters
- Working temperature 5 – 40 °C
- 50 or 60 Hz
- Tip speed of 8, 10 or 14 m/s
- Wide viscosity range
- Grinding in nano- and micrometer range
- ATEX certified

# CARBON MILLING LAB

## Description

The milling lab is used to tailor the particle size distribution of carbon materials.  
Configurable with: Shaper mill and Jet-mill or Impact

## Related equipment

Graphite materials preparation room.  
Particle size distribution analysis.

## Technical specifications

- Raw materials \*
  - Size from 0-2 mm.
  - Typical batch 5-10 kg.
  - Non-combustible dusts.
- Product \*
  - Typical d50 7 – 25  $\mu\text{m}$
  - Typical capacity 0,1 – 1 kg/h
  - Non-combustible dusts.

\* Contact technical staff for special requests.



# Induction furnace 75 kW

## Description

The 75kW induction furnace is among the most commonly used equipment in Elkem Technology. It is highly flexible and easy to adjust to your project's special needs. Switching linings/ crucibles is done within one day, which makes it very cost-effective. The furnace has a wide variety of extra equipment available, to ensure atmosphere- control, stirring (gas or mechanical). The 75kW unit has proven highly effective on melting most metals and slag within its temperature area.



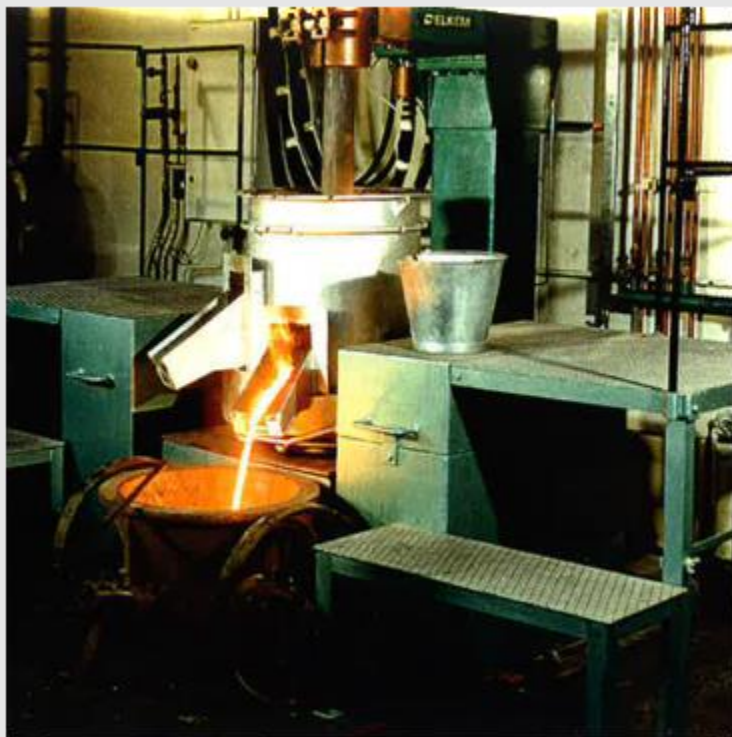
## Technical specifications

- Max workload 75 kW
- Frequency 3 kHz
- Water- cooled coil: Inner diameter 295 mm, height 350 mm
- Crucible (graphite, quartz, alumina) or a wide range of cast linings
- Active volume 15 L (90 kg Fe) with std oxide lining
- Furnace has been used for graphitisation tests at 3200K
- Hydraulic tilt and lip axis movement
- Eurotherm regulator for power and temperature control
- Logging and trending of power and up to 8 type C thermocouples simultaneously.

# Electric Arc Furnace 50 kW

## Description

The 50kW furnace has a rapid material flow rate, which means that for slag smelting processes a test can be done within a 12 h run. A typical test with Silicon or Ferro- alloys would typically last for 30-40 h. The 50kW was a key element in the early tests leading up to Elkem Solar's production of SOG- Si. It has also been used in tests to melt high-purity materials to form SOG- Si directly. The furnace has been used to study the silicon process by photographing and filming inside the crater during runs. The furnace can be placed on a circular rotating table, which gives a unique possibility of testing refractories exposed to molten slag in long-time runs.



## Technical specifications

- Max workload 60 – 75 kW
- Voltage range 10 – 140 V, continuously
- Current AC or DC
- Transformer cap. 150 kVA with a 5kA rectifier
- Furnace shape and size: circular, dia 400-600mm, depth 500mm, volume 60-150 l
- Furnace wall cooling air/water
- Electrode Top and bottom
- Electrode type and dia Graphite, 50 – 150 mm
- Hydraulic electrode regulator and stoker, 1 or more tap-holes. Can be used open or closed.



# Induction furnace 225 kW

## Description

The 225 kW is very flexible and easy to adjust to your project's special needs, combining a convenient size and power to melt. The furnace has a wide variety of extra equipment available, to ensure atmosphere- control, stirring (gas or mechanical), post furnace melt- treatment.

## Technical specifications

- Max workload 225 kW,
- Load frequency 3 kHz, water- cooled coil
- Coil : Inner diameter 475 mm, height 545mm
- Crucible (graphite, quartz) or a wide range of cast linings
- Active volume 30,0 L (230 kg Fe) with std graphite crucible setup
- Hydraulic tilt and lip axis movement and push- out ram
- Eurotherm regulator for power and temperature control
- Logging and trending of power and up to 8 type C thermocouples simultaneously.



# Induction furnace 250 kW

## Description

The 250 kW furnace shares a common auto transformer, power control unit, hydraulic tilting console and cooling system with its bigger brother, the Inductotherm 600 kW (1500kg Fe). The 250kW furnace is designed for melting all types of Ferro-alloys, silicon metals, aluminum, steels and cast iron. The coil is designed for rammed refractory lining or silicon carbide crucibles. It may also very well be equipped with a graphite crucible. The furnace may be equipped with a wide variety of extra equipment, to ensure atmosphere- control, stirring (gas or mechanical), post furnace melt- treatment. It can also be used in connection with a top blown reactor.

## Related equipment

- Casting simulator

## Technical specifications

- Max workload 250 kW, normal load 80 kW
- 380- 460 V, 675 kVA autotransformer, frequency 1 kHz
- Crucible (graphite, quartz) or a wide range of cast linings
- Active volume 35 L (250 kg Fe) with silica lining
- Hydraulic tilt and lip axis movement.



# Induction furnace 600 kW

## Description

The 600kW furnace shares a common auto transformer, power control unit, hydraulic tilting console and cooling system with the smaller 250 kW (250 kg Fe). The 600kW furnace is designed for melting all types of Ferro-alloys, silicon metals, aluminum, steels and cast iron. The coil is designed for rammed refractory lining or silicon carbide crucibles. It may also be equipped with a graphite crucible. The furnace may be equipped with a wide variety of extra equipment, to ensure atmosphere- control, stirring (gas or mechanical), post furnace melt- treatment.

## Related equipment

- Robot cell

## Technical specifications

- Max workload 600 kW, normal load 250 kW
- 675 kVA autotransformer, frequency 1 kHz
- Crucible (graphite, quartz) or a wide range of cast linings
- Active volume 235 L (1500 kg Fe)
- Hydraulic tilt and lip axis movement.



# Electric Arc Furnace (EAF) 100 kW

## Description

The 100-150 kW furnace is a multi-purpose furnace, as the furnace pot and lining can be changed for specific processes. The furnace can be equipped with water cooled shell. A separate filter collects the off-gas and dust, thus making it available for analysis, or as a product. The furnace can be equipped with top-bottom electrodes, or with two top electrodes. A wide range of processes has been evaluated using this furnace.

## Technical specifications

- Max workload 150 kW
- Voltage range 15 – 148 V (1,5 V steps)
- Transformer capacity 300 kVA
- Furnace shape circular or oval
- Furnace size dia circular 500-700 mm  
oval 1050x750 mm  
depth 500 mm  
volume 200-400 l
- Furnace wall cooling: air/oil/water
- Electrodes Top and bottom
- Electrode dia and type 100 – 150 mm, graphite

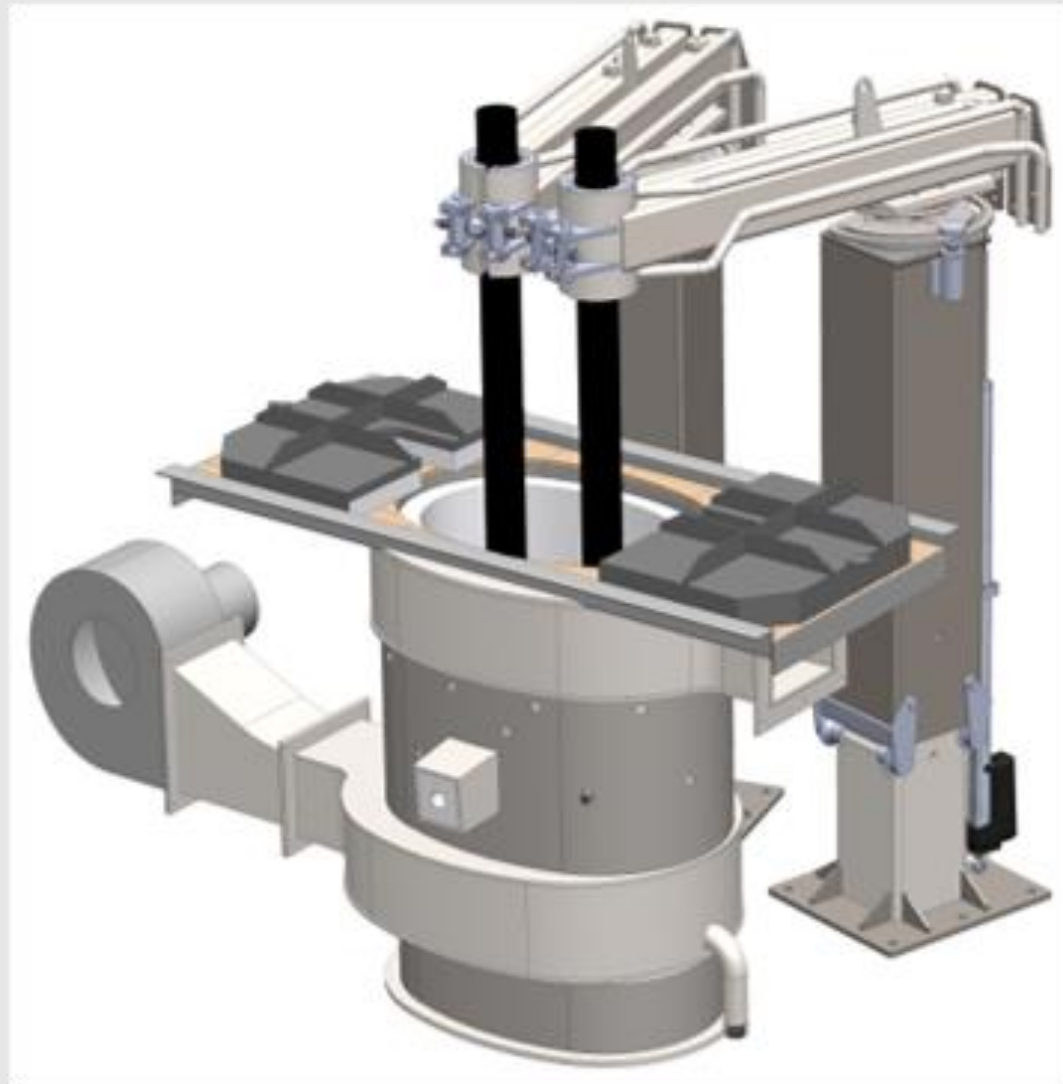


The picture shows the 100 kW with a calcination furnace installed

# Electric Arc Furnace 100 kW

## Description

The Electric Arc Furnace is a single-phase, two electrode furnace suited for reduction of metal, ores and by-products.



## Related equipment

Carbolite furnace (Muffel furnace for calcining)

## Technical specifications

- Max workload 100 kW
- Voltage range 10 – 150 V, continuously
- Single-phase alternating current
- Transformer cap. 150 kVA with a 5kA rectifier
- Oval shaped process cavity with a long axis of 720 mm, internal depth 400 mm and volume of 100 liters.
- Temperature monitored air and water wall cooling.
- Two electrodes with electrical adjustable elevation
- Electrode type and diameter: Graphite, approx. 100 mm
- Bottom tapping
- Two top electrodes

# Pyrolysis furnace

## Description

50 litre pyrolysis furnace with possibility of off gas thermolysis and analysis developed for Li-ion module pyrolysis in 7-10 kg scale

## Related equipment

Muffle furnace

Tube furnace

## Technical specifications

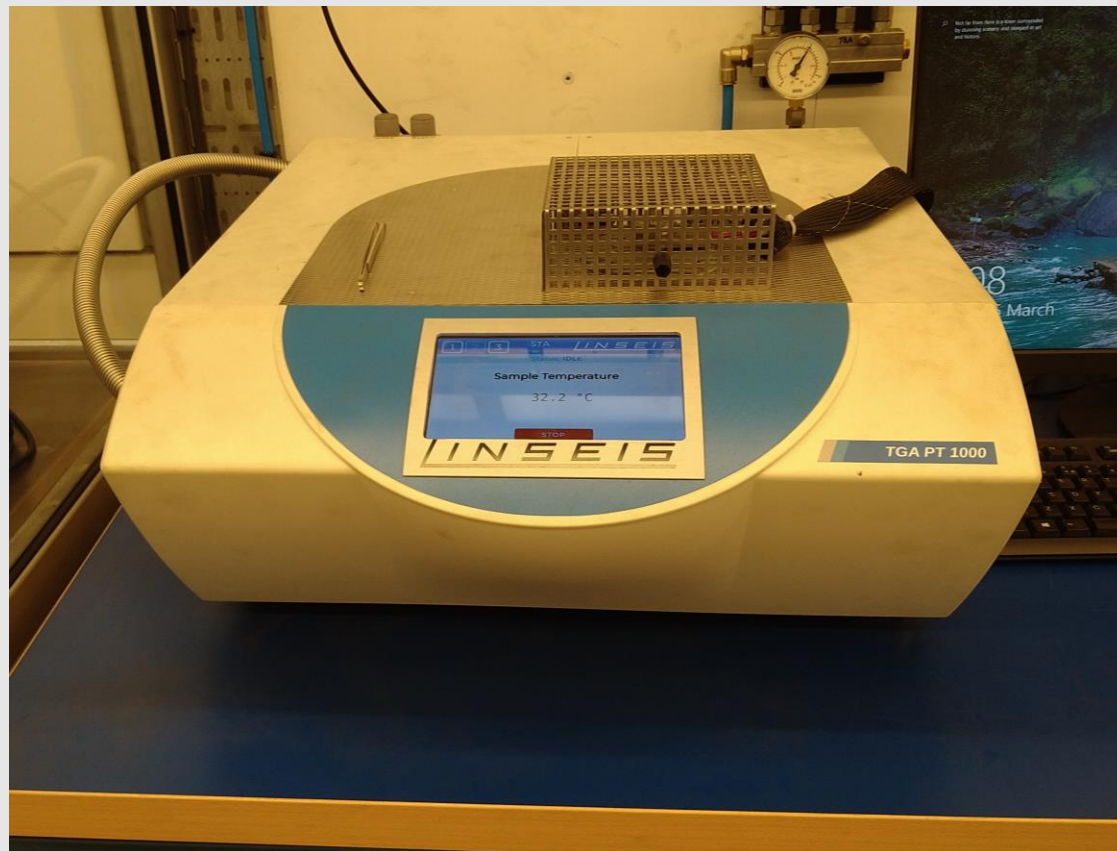
- Pyrolysis at  $T_{max}$  1100°C
- Solid 50 litre material chamber for potentially volatile conditions
- Under (air)- or overpressure setting
- Possibility of gas mixing and controlled thermolysis of offgases
- 1.500 m<sup>3</sup>/h jet scrubber connected
- Preheater for introducing hot gas into the process chamber
- Pressure and temperature measurements at all critical points
- Off gas measurements pre and post scrubber (MS, bubble flask train)
- Condensate collection arrangement



# Linseis TGA

## Description

Linseis PT1000 thermogravimetric analyzer for weight loss analysis during heating



## Related equipment

Muffle furnaces

Tube furnaces

Induction furnaces

## Technical specifications

- Sample weight up to 5mg, Al<sub>2</sub>O<sub>3</sub> crucibles
- Max temperature 1150°C
- Vacuum, Ar, N<sub>2</sub> or air atmosphere
- Calculated DTA
- Ready for Mass Spec or micro GC connection

# Eirich- mixer

## Description

Eirich- mixer EM5 for mixing and powder pelletization



## Related equipment

Planetary mixer

Pelletizing disc

Briquetting machine

## Technical specifications

- Max sample volume: 3 liters
- Star shaped impeller head
- CW and CW impeller rotation
- CW bowl rotation at two fixed speeds
- Frequency converter for stepless impeller RPM adjustment in the range of 400- 12.000 RPM



# Lab extruder

## Description

Bonnot lab extruder



## Related equipment

Pelletizing disc

Eirich- mixer

Roller press briquetter

## Technical specifications

- Twin screw feeder
- Max capacity: 8- 10 kg/h
- 2mm and 3,2mmØ die plate holes
- Continous pressure and temperature readings
- Stepless screw speed up to 43 RPM max- highly adjustable system pressure

# Strength measurement

## Description

Chatillon CS2 multi purpose equipment



## Related equipment

Large scale compression strength tester

Sievers

Agglomeration equipment

Driers

## Technical specifications

- Max workload:
  - Small cell- 4 kg
  - Large cell- 100 kg
- Compression and tensile strength measurements
- Automatic sample size measurement

# Skeleton density

## Description

Micromeritics Accupyc II 1345 skeleton density measurement



## Related equipment

Micromeritics Geopyc envelope density  
Duo tap density analyzer  
BET

## Technical specifications

- Sample size up to 1 dl
- Ar, N2 or He atmosphere
- For both powders and solids

# Malvern Mastersizer

## Description

The Malvern Mastersizer is particle size distribution analysis, where measurements can be done both dry and wet.

## Related equipment

Controlling particle size in relation to milling (WAB, Netzsch ZETA25).



## Technical specifications

- Require small samples 1-20 g
- Dry and wet measurements possible
- Measurement range from 10 nm to 3,5 mm
- Particle size distribution measured by laser diffraction

# Spark OES

## Description

Spark Series is a high-end metals analyzer that can analyze elements with high accuracy and precision. Used for defect analysis cast iron and trials.

## Related equipment:

Related equipment for cutting and melting

## Technical specifications:

ThermoFisher scientific equipment:

- ARL 8860 instrument
- Paschen-Runge vacuum polychromator
- Flexible and powerful Thermo Scientific™ OXSAS™ Analytical Software.
- Special cast iron cabinet, temperature controlled to  $\pm 0.1^\circ$  at  $38^\circ\text{C}$ .
- Argon flushed, water-cooled table with self-contained, closed loop coolant system.



# X-ray fluorescence (XRF)

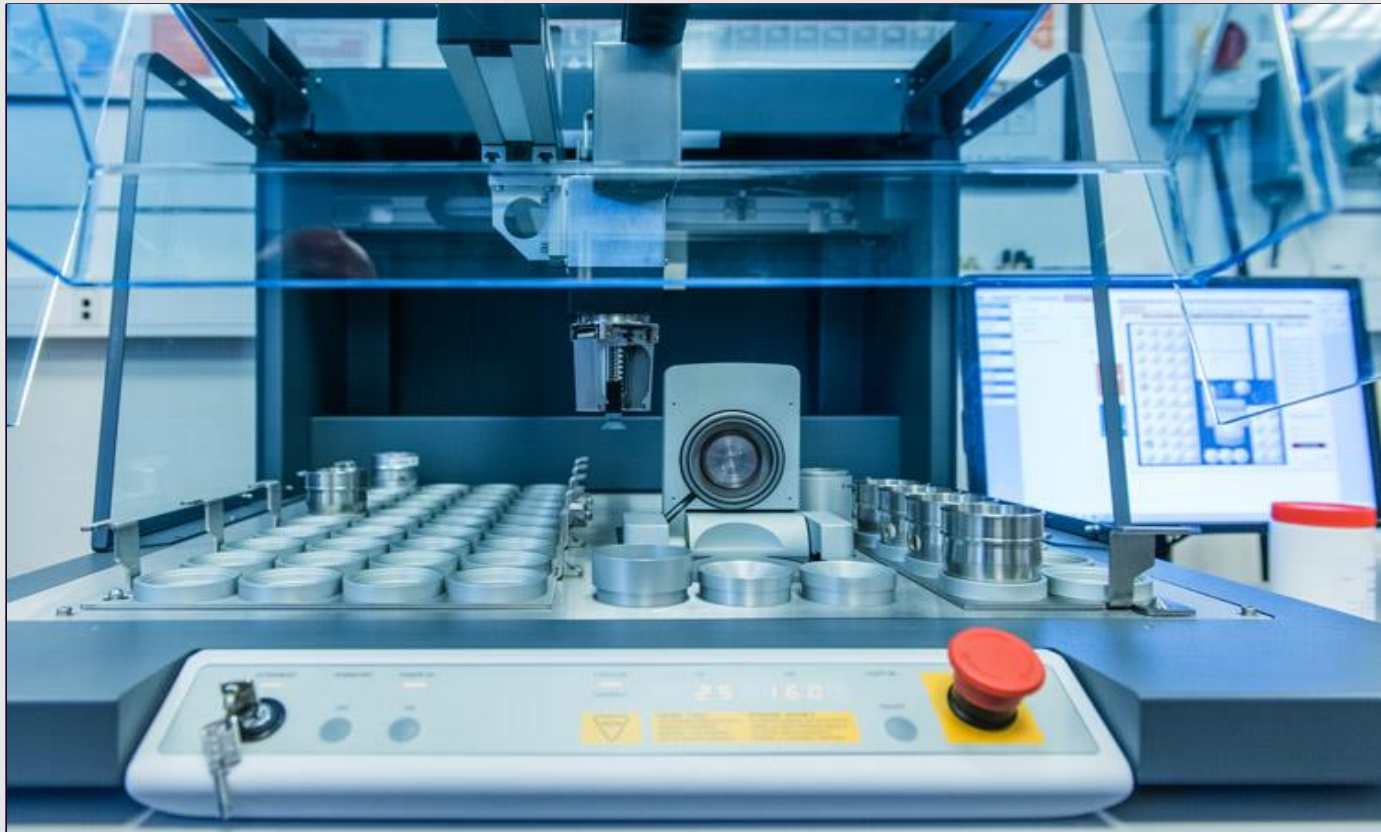
## Description

XRF is used for chemical analysis of a wide variety of materials: metals, alloys, slag, minerals and other oxides.

XRF require solid sample materials, and is a fast and accurate method for elements in a concentration range generally between 10 ppm and 90%.

## Related equipment:

Equipment for sample preparation: Crushers, mills and induction furnace for glass bead fusion.



## Technical specifications:

- Malvern PANalytical wavelength dispersive XRF (WD-XRF)
- 4 kW rhodium tube
- 48 position automatic sample changer
- Measure most elements from Na to U (gaseous elements excluded)
- Typical reporting limits, powder briquettes: 10-50 ppmw
- Typical reporting limits, fused glass beads: 50-100 ppmw
- Existing applications for:
  - Silicon
  - Ferrosilicon alloys
  - Slags
  - Oxidic minerals and powders
  - Ash from carbon reduction materials
  - «Omnia» semiquantitative analysis

# X-ray diffraction (XRD)

## Description

XRD identify and quantify the crystallographic structure of a material. The technique is used to determine the crystallographic phases in solid materials, to determine which phases are present.

## Related equipment:

Equipment for sample preparation: Crushers, mills, mortar.



## Technical specifications:

- Bruker D8 advance XRD
- 435 mm Bragg-Brentano diffractometer
- Cu K $\alpha$  radiation with Ni filter
- Position sensitive detector, Lynx eye
- Topas 5.0 Non-linear LSQ pattern analysis
- PDF-2 2016 database
- 90 position auto-changer with BBQ automation

# Plasma spectroscopy: ICP-OES

## Description

ICP-OES is used for determination of elements in solutions, normally after digestion of a sample material in acids.

The main advantage of ICP-OES is the capability to measure low concentration levels. For some elements, ICP-OES may quantify below 1 ppm.

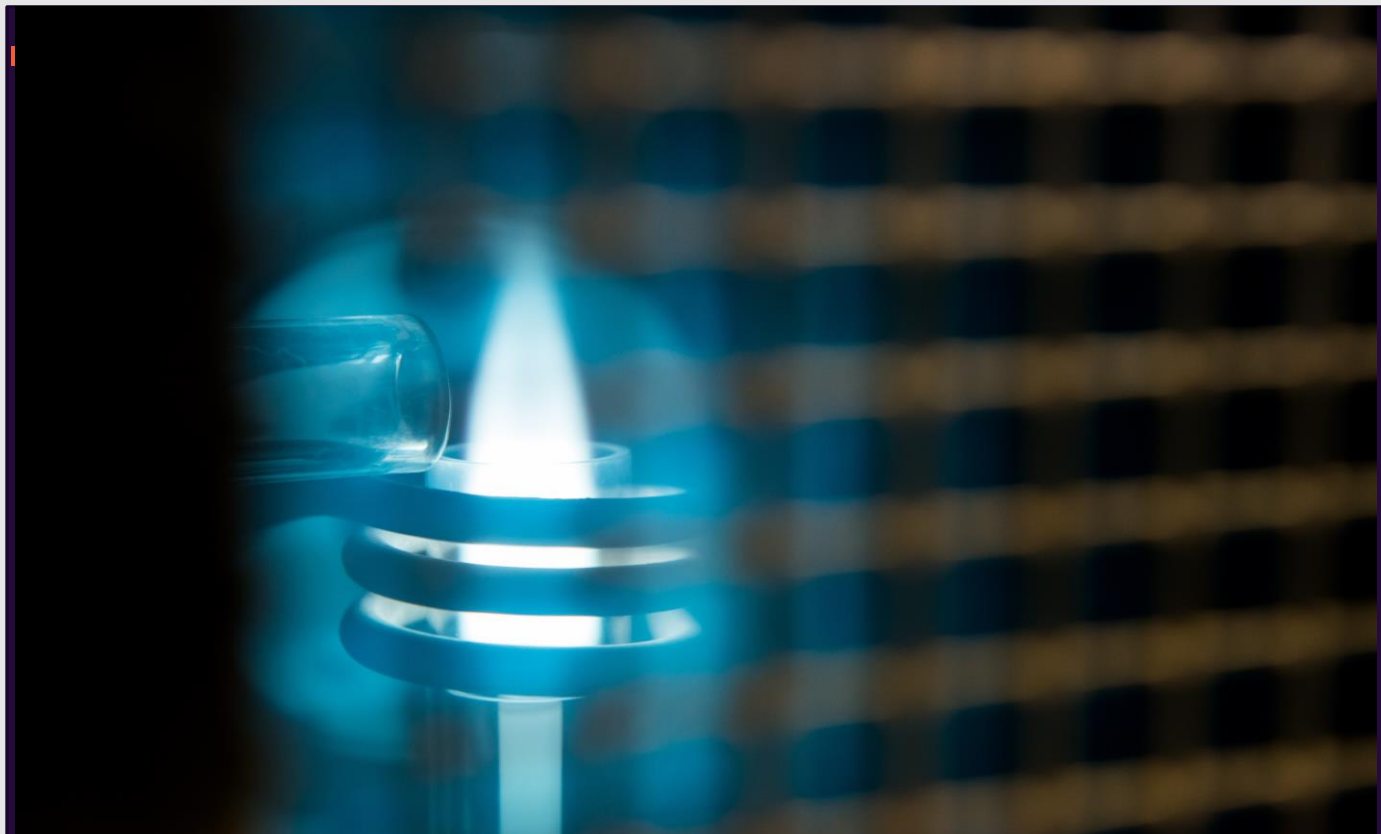
## Related equipment:

Microwave ovens for decomposition of samples like quartz and other oxides

Other equipment for decomposition in selected acids.

## Technical specifications:

- Spectro Green ICP-OES with autosampler
- Radial plasma
- CCD detector with wavelength range from 165 – 770 nm
- Existing applications for:
  - Minor and trace elements in silicon
  - Trace elements in ferrosilicon alloys
  - Trace elements in quartz and oxides
  - Minor and trace elements in ash from carbon materials
- Applications for other materials and elements may be developed on request





# Combustion analysis

## Description

Combustion analysis (often referred to as «LECO analysis») is widely used for determination of carbon (free and total), sulphur, oxygen, nitrogen and hydrogen in a wide variety of materials.

## Related equipment:

Preparation equipment for crushing, cutting and milling

## Technical specifications:

LECO instruments at Technology Lab:

- LECO RC 612 for determination of hydrogen and carbon. Temperature ramping during measurement enables separation and detection of free carbon and graphitic carbon
- LECO XXXX for determination of carbon and sulphur
- LECO xxxx for determination on oxygen, nitrogen



# Mass Spectrometer : GC-MS

## Description

Gas chromatography is used to separate the volatile molecules from each other while the mass spectroscopy is used to identify them by comparison with standards or mass spectrometry from a library.

## Related equipment:

TG-PAH GC column, 60x0,25mmx0,1  $\mu\text{m}$   
Diverse chemicals for sample preparation



## Technical specifications:

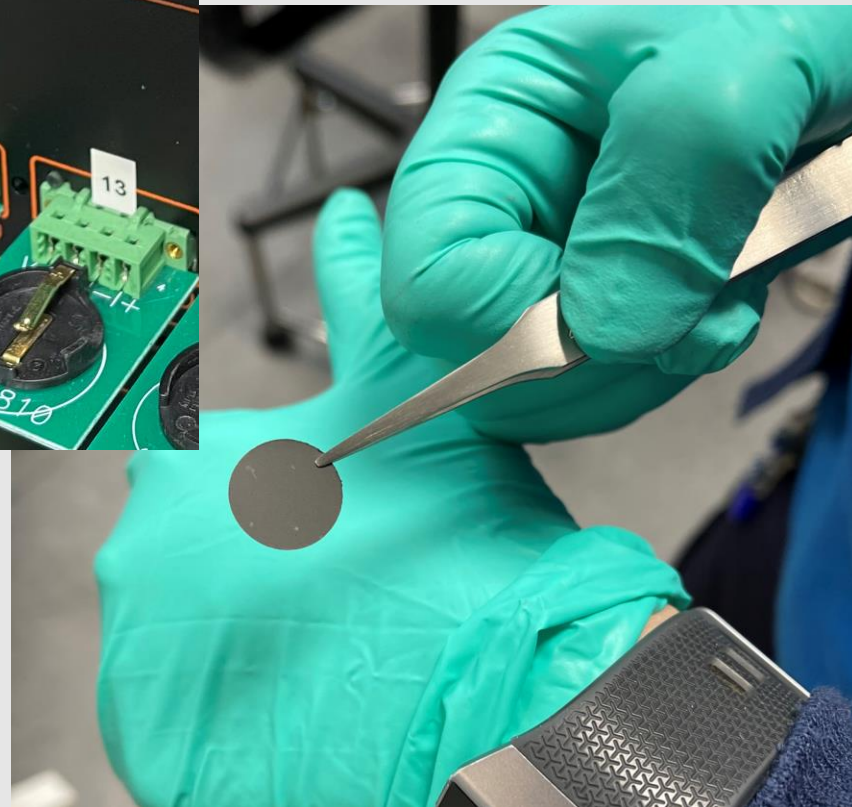
ThermoFisher scientific equipment:

- Trace TM 1310 Gas Chromatograph
- Trace 1300 SSL Injector module
- AS 1310 autosampler, 155 Vials
- ISQ LT Mass Spectrometer (MS), stor turbopumpe
  - Stor turbopumpe
  - Extractabrite EI source
  - Change EI/CI source without venting the MS Chromeleon version 7.3
- Chromeleon version 7.3
- NIST 2020 MS Library

# Battery Coin Cell Lab

## Description

Fully equipped Coin cell lab for testing anode material (graphite and silicon).



## Related equipment:

Equipment for crushing and milling of material. A range of support chemical analysis like XRF. In addition to characterization (XRD).

## Equipment:

- BET - QuantaChrome NovaTouch
- Coin Cell testers - Neware
- Mixing centrifuges
- Coating equipment
- Glovebox
- XRD

# Surface Area and Pore Size Analysis

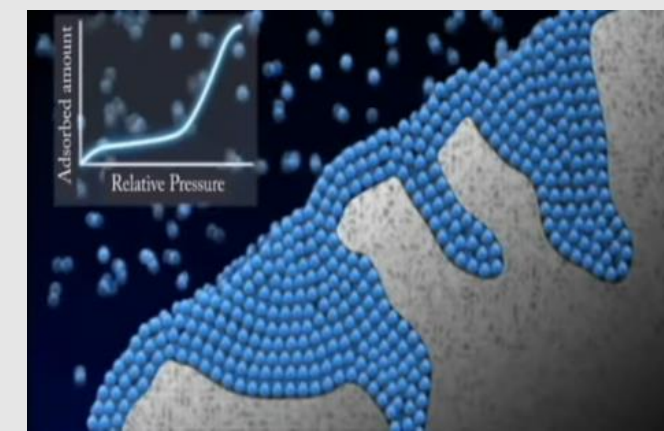
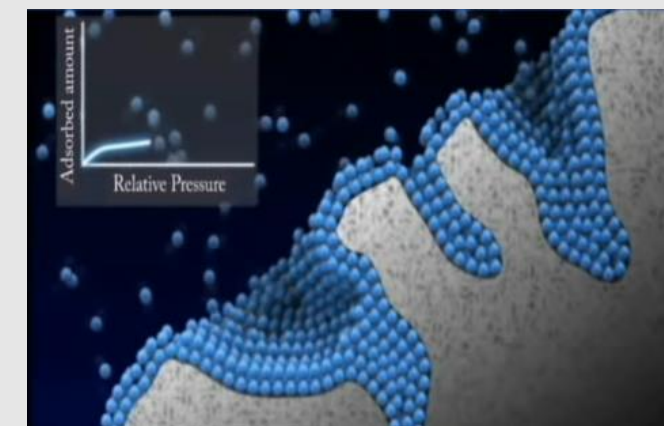
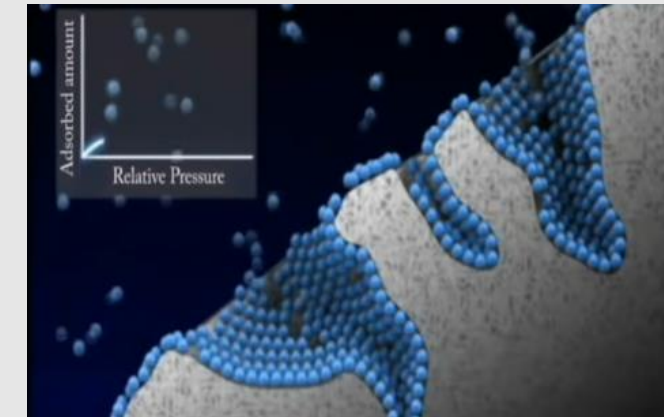
## Description

The measurement of a materials' specific surface area (SSA) and porosity is sometimes of fundamental importance. The reaction rate increases with surface area. This is directly used in catalysis and in nano materials. For example, dropping nano-Si particles into water will release a large amount of H<sub>2</sub> gas in seconds. As another example, the relationship between specific surface area and particle size of a powder can tell an engineer something about the state of agglomeration. One of the most prominent areas of use in Elkem is within battery materials research.



## Technical specifications

- Measurement types:
  - B.E.T. specific surface area
  - Adsorption and Desorption Isotherms
  - Micropore analysis
  - Mesopore Size distribution
- Analysis stations: 4 simultaneous
- Adsorbate: Nitrogen
- Surface area range: 0.01 m<sup>2</sup>g<sup>-1</sup> to no known upper limit
- Pore size range: 0.35 to 5000 nm
- p/p<sub>0</sub> resolution: 6 x 10<sup>-8</sup>
- Degassing Vacuum, ambient to 400°C



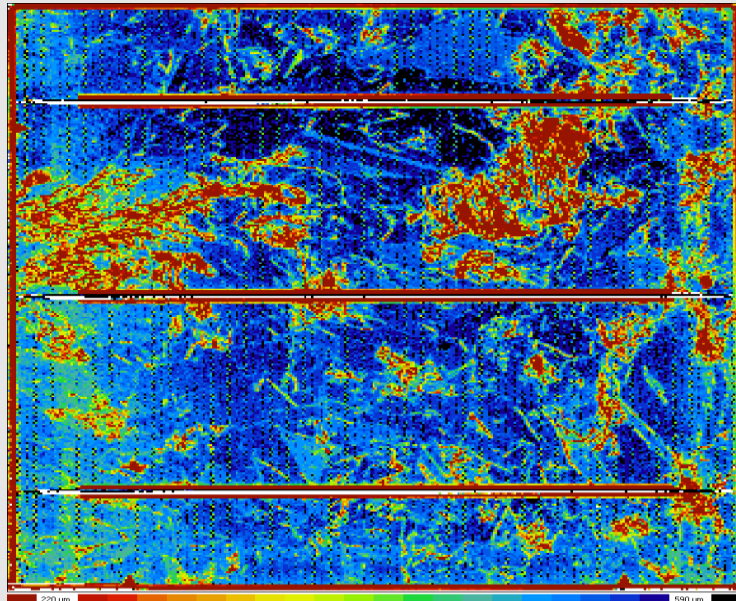
# PV Lab (Photovoltaic Lab)

## Description

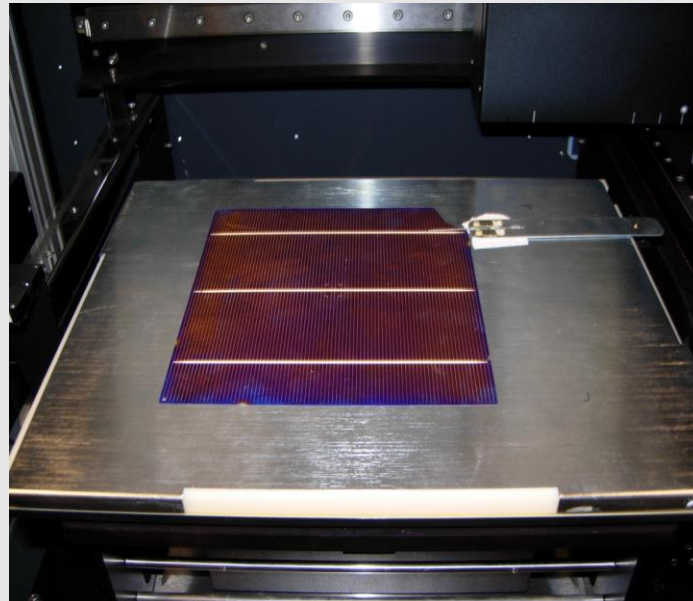
Preparation and characterisation of Solar Grade Silicon materials.

## Range of application

Characterisation of Solar Grade Silicon blocks, wafers and cells.

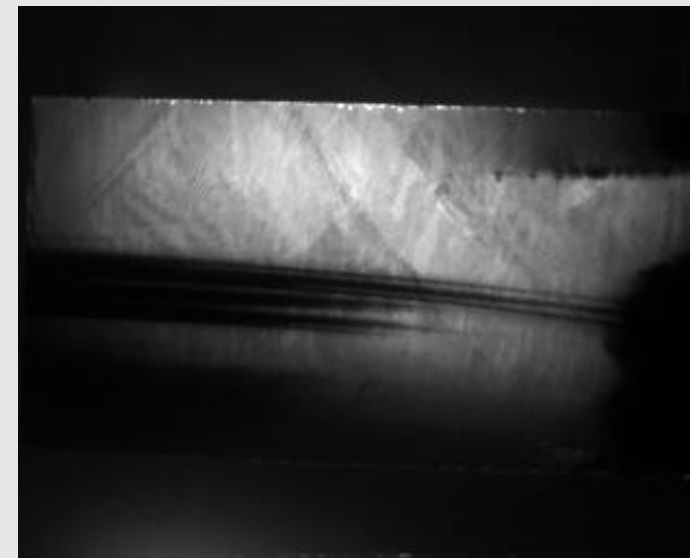


LBIC diffusion length measurements on Solar cells



## Instruments

- [Semilab](#) (WT-2000) instrument for measuring Lifetime, resistivity, PN-junction and LBIC
- FTIR for measuring  $O_i$  and  $C_s$
- IR-Microscope
- IR-Camera
- Etching possibilities
- Precision cutting and preparation



IR-image of a slice of Sog-Si

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# Scanning Electron Microscope (SEM)

## Description

A scanning electron microscope (SEM) is a microscope that produces images of a sample by scanning the surface with a beam of electrons. The electrons interact with atoms in the sample, producing signals that contain information about the surface topography and composition of the sample

## Range of application

“A SEM is utilized in most every material challenge, whether its development work, troubleshooting or documentation of microstructure and chemistry.”

- Identification of phases and particles
- Size and classification of particles and phases
- Microstructure investigations
- Examination of material defects
- High magnification and high-resolution imaging

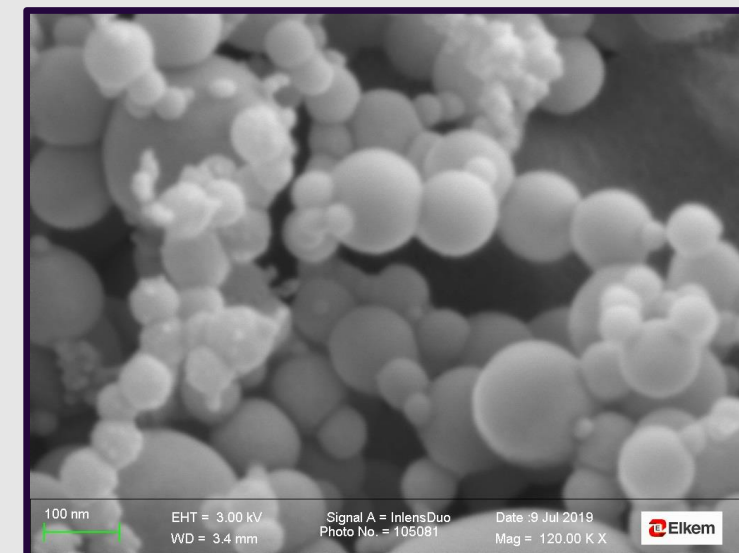
## Specifications

- “FEG-SEM”- Field Emission Gun-Scanning Electron Microscope
- Model: Zeiss Merlin Compact with;
- Secondary, backscatter and in-lens duo detectors

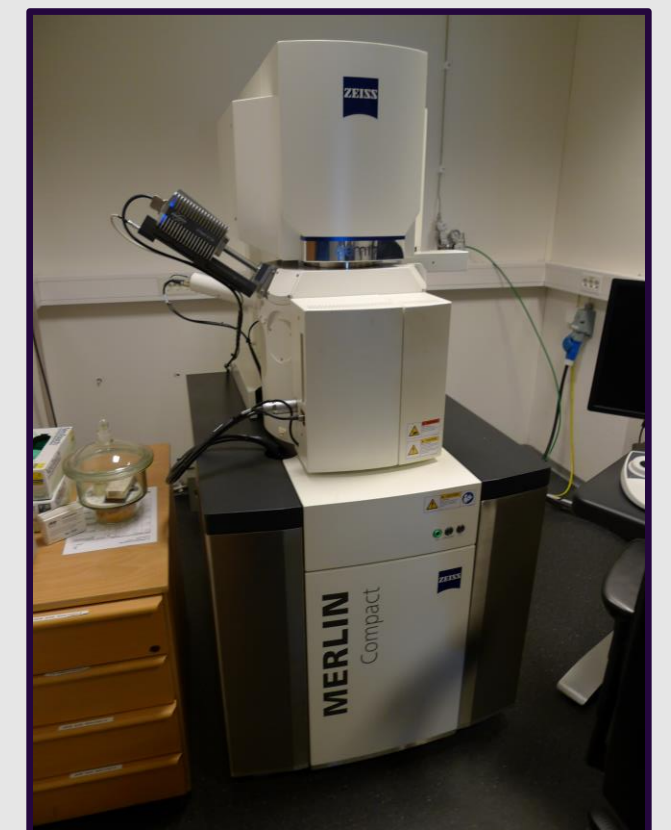
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Nano size particles at 120 000X



# Energy Dispersive Spectroscopy (EDS) coupled with AMICS

**EDS** is an analytical technique used for elemental analysis or chemical characterisation of a sample. It relies on X-ray excitation from a sample after it has been hit by a beam of electrons.

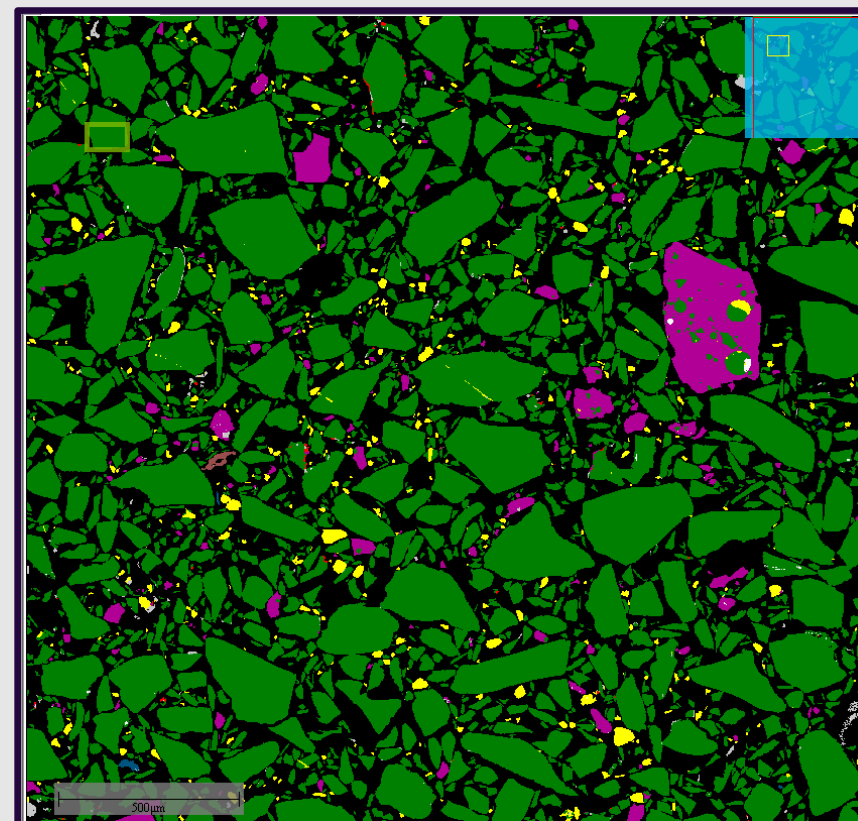
**AMICS** is a software part of an analysis branch called Automated Mineralogy. It is a method of performing high speed, autonomous image and spectral analysis of rocks and minerals and provides information on mineralogy and spatial distribution of the mineral phases.

## Why?

*We can identify and quantify phases and impurities in materials by the means of point analysis, element mapping or line scan. With AMICS we can map and quantify the chemical composition over large areas.*



EDS-Detector

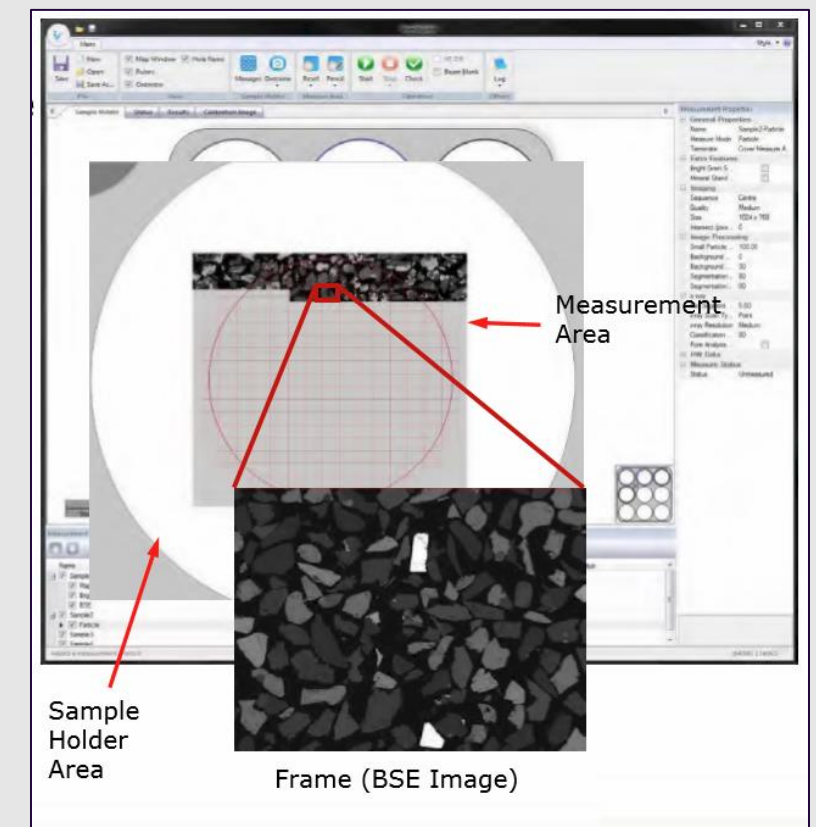


Mapping of impurities with AMICS

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Principle of mapping with AMICS

# Stereo Microscopes

## DESCRIPTION

Low magnification microscopes coupled with digital cameras for 3D inspection and documentation.

## SPECIFICATIONS

- 5-150X magnification
- Digital imaging
- Both ring and inclined illumination
- High working distance

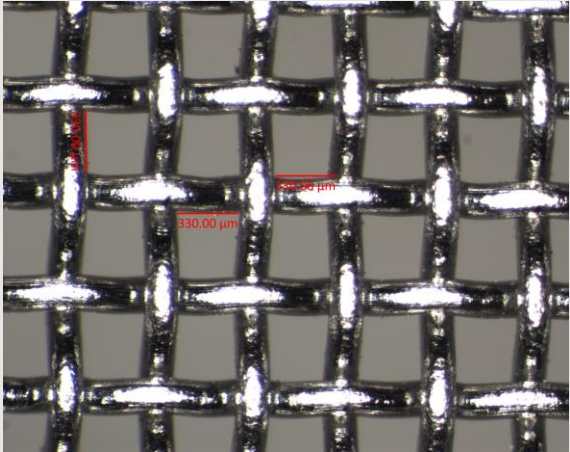
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## RANGE OF APPLICATION

For examination of topological samples such as powders, defects, fracture surfaces etc.



Examples



# Optical Microscopes

## DESCRIPTION

High magnification microscopes coupled with digital cameras for polished cross sectional analysis and documentation.

We have OM from Lecia, Zeiss and Olympus.

## RANGE OF APPLICATION

All kind of materials such as metals, ceramics, polymers and powders.

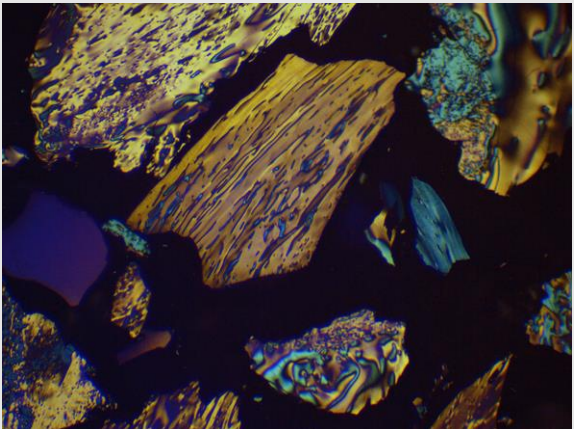
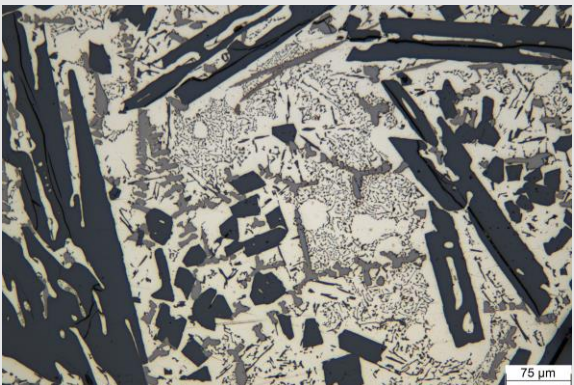
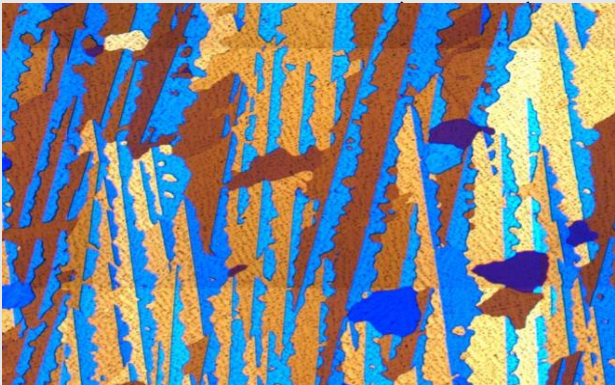
## SPECIFICATIONS

- 25-1000X magnification
- Digital imaging
- Suited for Image Analysis
- Incident Light: Bright Field, Dark Field, Polarisation, Fluorescence and Differential Interference

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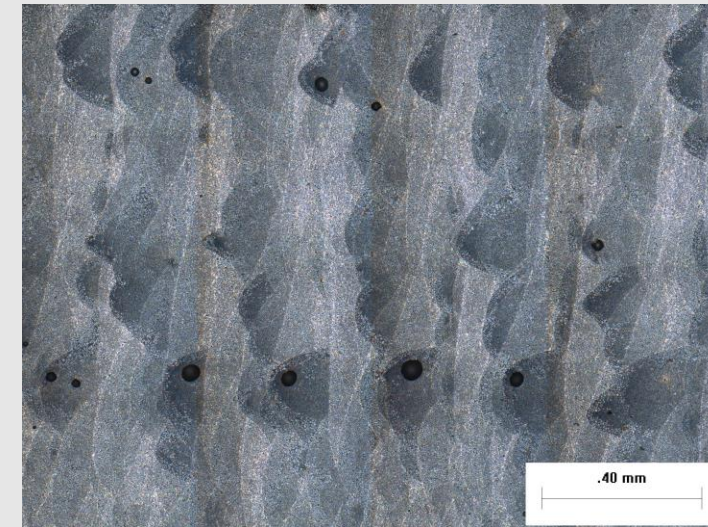
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Examples

# Metallographic lab

Metallography is the science and art of preparing a specimen surface for analysis by cutting, mounting, grinding, polishing and etching to reveal the specimen's true structure. The information revealed by specimen analysis makes it possible to determine whether the material is qualified for the intended application, and to assess and improve the manufacturing process (Struers.com).



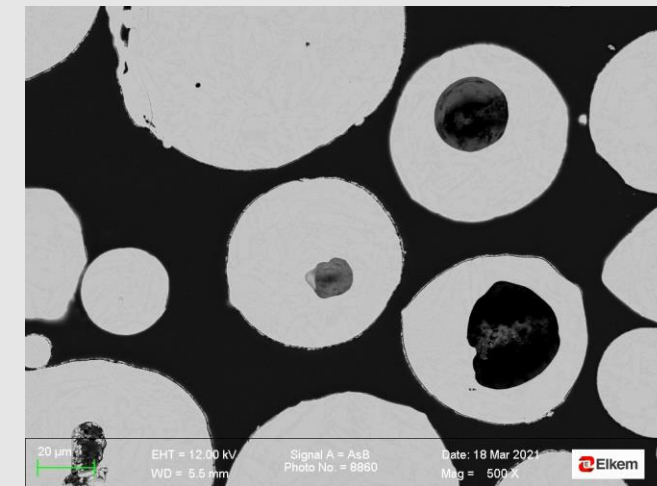
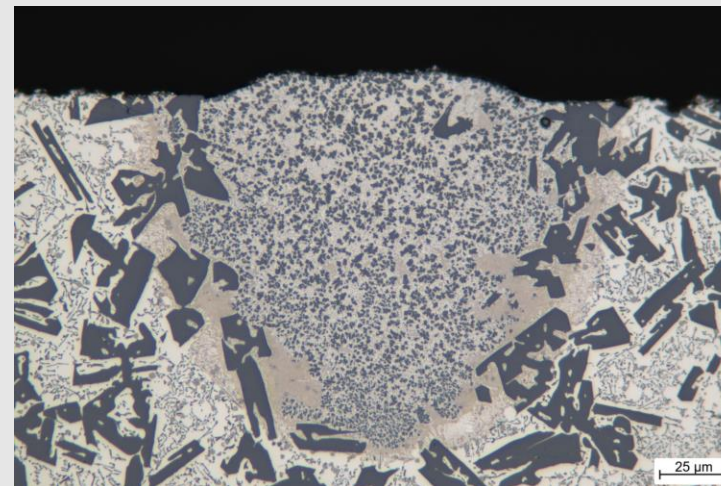
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## Our equipment includes:

- Automatic prep stations
- Cutting machines
- Manual prep stations
- Vacuum embedding of samples in epoxy
- Etching, including electrolytic etching



Examples of samples prepared at our lab.

*“We can investigate and prepare all types of materials: metals, ceramics, polymers and powders.”*

# Instrumentation Workshop

## Temperature measurements & other instrumentation

### Description

- High temperature measurements in harsh environments



### • Equipment

- General purpose thermocouples
  - 0-2300°C
- Custom made thermocouples
  - Type K, S, B & C
  - Various types of protection tubes
  -
- Optical temperature measurements
  - >3000°C
  - Pyrometry
  - IR
  - Fiber-optic
  - Multi-spectral imaging
- Calibration
  - Traceable to international standards

# Pilot Mechanical Workshop

## Plates, Pipes & Profiles

### Description

Pre-assembly preparation of plates, pipes & profiles



### Related Equipment

- Welding Table & Machines
- Manual Plasma Cutting
- Machine workshop, Turning & Milling.
- Tube & Pipe Bending
- Pipe Threading
- Hydraulic Press

### Technical Specifications

- CNC Plasma Cutting

Thickness max 40 mm  
 Dimensions max 1500 X 3000 mm

- Rolling 1

Thickness max 15 mm  
 Diameter min ø210 mm  
 Width max 3000 mm

- Profiles cutting

Length 6000 mm  
 Max profile 200X200 / ø250 mm

- Sheet Metal Bending (Manual)

Thickness max 2 mm

Limiting width 1 020 mm

- Rolling Sheet Metal (Manual)

Thickness max 2 mm  
 Diameter min ø60 mm  
 With max 600 mm

# LATHE SN 71C 3000mm

## Characteristics

Semi-automatic lathe, mostly used for graphite & metallic materials. Plastics also possible.

- Maximum spindle length 3000 mm.

\*

- Maximum clamping diameter Ø560mm.

- Square & round billets possible.

Maximum turning diameter Ø710 mm.

\* Similar lathe with maximum spindle length of 2000 mm, also available.

## Related equipment

Steady-rests ø10-ø360 mm available.



# Band Saw: Beka-mak – BMSY 560 C

## Application

Cutting of round and square bars/billets.

## Technical specifications

Billet maximum dimensions:

- Height 560 mm
- Width 580 mm
- Length up to 3000 mm



# Storage tent

Approximately 1200 square meters available for storage of raw material, products and equipment



# Baghouse filter



## Description

The bag house is connected to all installed equipment for raw material handling and metallurgical test in the pilot plant. The bags are cleaned by reverse flow. The dust is collected in containers placed on load cells. The amount of dust is continuously recorded at the bag house control panel.

## Technical specifications

- Type: AMECO, Hamar, Norway
- Capacity: 40 000 m<sup>3</sup>/h at 50° c (33.800 Nm<sup>3</sup>/h)
- Bag type: Gore-Tex. Membrane/Nomex filter bag
- No. of bags 480 (place) 380 (installed)
- Bag dimensions:
  - Length 3200 mm
  - Diameter 128 mm
  - Area 1.29 m<sup>2</sup>



# Wet scrubber



## Description

The wet scrubber is connected to the main off-gas pipe system and can therefore collect dust and gas from a wide variety of furnaces and equipment.

The scrubber consists of a scrubbing vessel, an entrainment separator, a tank for collecting and treatment of scrubbing liquid, a tank for neutralizing chemicals, pump systems, and an exhaust stack.

## Technical specifications

- Capacity: 1500 m<sup>3</sup> off-gas per hour

# Vertical tube furnace – Vacuum / Inert atmosphere



## Description

George, a vertical tube furnace with superkanthal elements. The furnace allows tests under vacuum.

## Technical specifications

- Temperature up to 1650°C

*Vertical tube furnace –  
Vacuum*



## Description

Malin, a vertical tube furnace with superkanthal elements. The furnace allows tests with controlled atmosphere for inertia.

## Technical specifications

- Sample volume maximum 0,7 liter
- Temperature up to 1600°C
- Controlled atmosphere

*Vertical tube furnace – Inert  
atmosphere*

# Sifters and screeners



## Description

- Allgaier 3 fractions+ bottom
- Kason 4 fractions
- Retsch VE 1 Fraction: 25 - 3500  $\mu\text{m}$ , Screen size 200 mm, Amplitude: 0,2 - 3 mm
- Splitters low capacity, manual

## Spec for the facilities:

Crushing and screening batches under 1000 kg down to ~ 1 mm with good capacity.



## Technical specifications

- Allgaier 0,06 mm – 15 mm
- Kason 0,2 mm - 22,4 mm
- Retsch VE 1 0,2 mm - 3 mm
- Splitters

# Crushers



## Description

The crushers is used to crush the different samples to the desired size.

## Technical specifications

- Jaw crusher Retsch BB300  
<120mm in, >1mm out, ~600 kg, Si/ hour
- Jaw crusher Morgårdshammer  
<70mm in, >2mm out
- Roller crusher Svedala  
<10mm in, >1mm out

# Muffle furnaces

## Description

A chamber furnace for incinerating, curing, tempering, hardening, and forging of larger objects. The oven is fitted with Kanthal elements and has a maximum temperature at 1340°C.



## Related equipment

Tube furnace

## Technical specifications

- Dimensions cm (W x H x D) 100 x 100 x 220
  - Volume 2,2 cubic meters
  - Temperature up to 1340°C
  - Inert gas casing
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- Dimensions cm (W x H x D) 19 x 20 x 30
  - Volume 0,01 cubic meters
  - Temperature up to 1400°C

