FUTURE MATERIALS

NORWEGIAN CATAPULT CENTRE

– At a glance

Catapult Centre partners

ARENDALS FOSSEKOMPANI

Elkem

Mechatronics Innovation Lab

norner™ The Polymer Explorers

ReSiTec

UiA University of Agder

Future Materials Norwegian Catapult Centre

Future Materials is a national test and development center for materials. The center aims to bridge the gap between the initial idea phase and pilot scale production.

At our facilities you will be able to develop, test and verify your products on a pilot or industrial scale. The material is at the core of our business and together we find the best solutions, be it plastic, composites, metals or other materials. Through the improvement of material properties, your product can also be better utilised and reused in a circular perspective.

Production of advanced products requires fundamental understanding of the materials' composition and properties. Future Materials excel at the development of new materials, and we aim to get even better.

Catapult projects

Research projects

FUTURE MATERIALS

NORWEGIAN CATAPULT CENTRE

Our Sites:

Krossen, Kristiansand

Glamsland, Lillesand

Porsgrunn

Kristiansand

Grimstad

Equipment usage

A customer needed a 225 kW induction furnace for heat treatment of samples.

While Elkem's expertise ensured high quality and safe operation of the furnace, the customer focused on making notes during the test.

They left our site with a smile on their face.

We have no idea how the customer wanted to use the result. And we don't need to know – as the IP always belongs to the customer.

Elkem

Pilot testing

A customer wanted to mill a material down to a powder of 50-100µm with specific properties.

Based on the customer's requirements and samples, we advised to use a ball mill for this operation.

A successful pilot test was done with milling 100kg. This material was used by the customer for product development.

After the testing we have offered to scale up the process in the Catapult Centre or alternatively assist the customer to install their own production facility.

ReSiTec

Additive Manufacturing I

A company serving the oil industry wanted to test a new product design.

3D printing is often the most cost effective production method for pilot or small scale production. For this test we used a powder bed printer to produce a set of prototypes made in aluminium. The customer tested the prototypes with good results.

Mechatronics Innovation Lab has completed more than 60 3D print projects in total on printers for metals (powder nozzle and powder bed), plastic and composites.

Mechatronics
Innovation Lab


ABB

Additive Manufacturing II

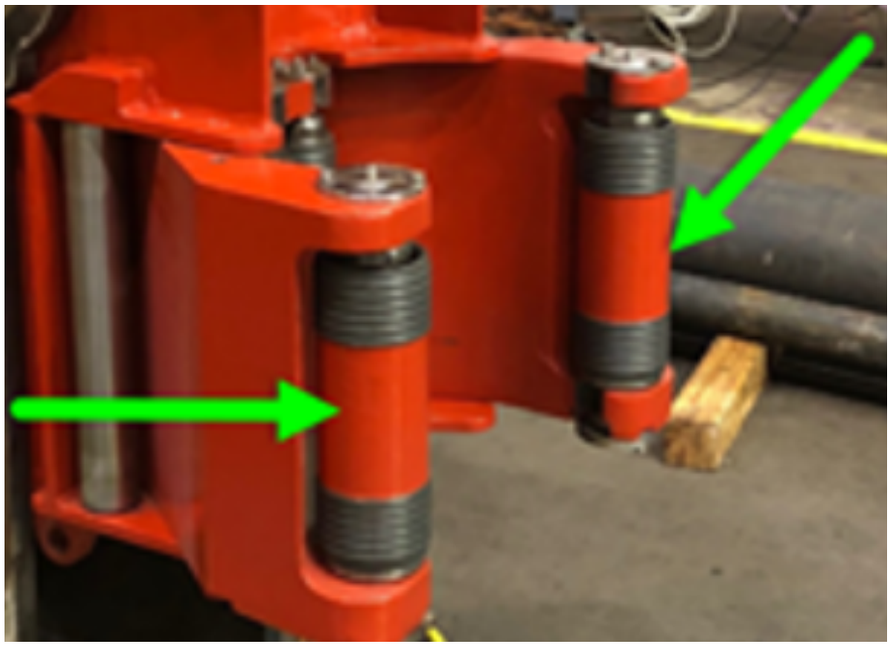
Kitron needed several new parts for their production lines, like palettes and robot grippers.

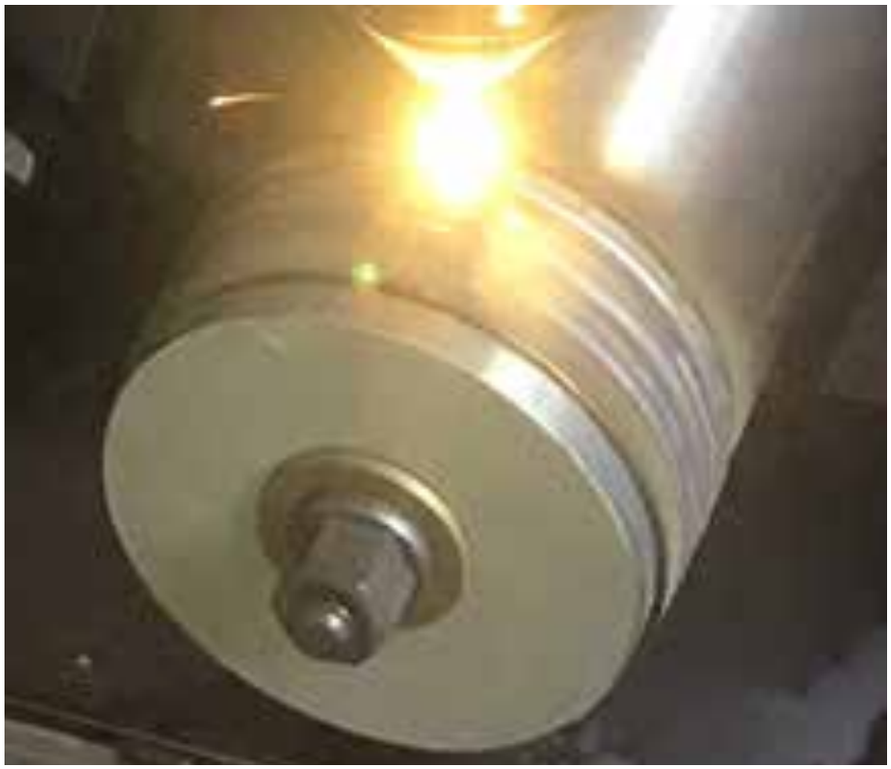
We used a composite printer to produce parts made of carbon fiber reinforced plastic.

Compared to machining, 3D printing the parts resulted in significantly shorter lead time and large cost savings.

Kitron has subsequently invested in several 3D printers for both internal and external deliveries.

Mechatronics Innovation Lab





Additive Manufacturing III

MH Wirth wanted to test a new material for wear pads to increase the life of a hard-wearing component.

We used a *laser deposition welding printer* to produce a test series of the component, printing tool steel grooves on a regular steel pipe. The new design, material and production method resulted in much higher durability and increased service life.

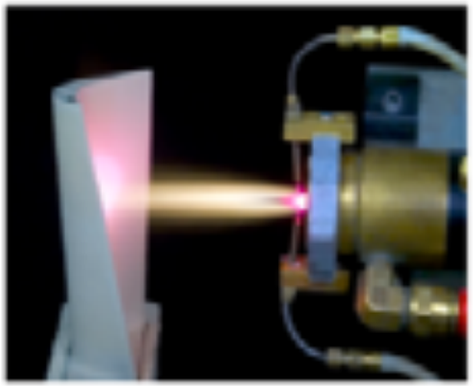
Using additive manufacturing as production method for the component, different materials could be combined in a way significantly reducing the raw material costs.

Mechatronics Innovation Lab

From material properties to **value proposition**

SiC properties

- Extreme hardness
- Low density
- Low friction coefficient
- High thermal conductivity
- Low thermal expansion coefficient
- Chemically inert



ThermaSiC

Value proposition

- Increased life-time
- Lower maintenance costs
- Lower weight
- Hard chrome alternative

Industrialization of process

Seram Coatings has developed a world leading method in how to deposit silicon carbide on components, but they needed help to optimize their pilot process line to increase yield. This was so successful that the next step was to gather a competent team and help them build a full production line sorting out challenges like:

- Which equipment should be evaluated?
- Which parameters are important?
- How do we design the process line for further upscaling?
- How to handle side streams and by-products?

ReSiTec

Hazardous waste cleaning

Langøya landfill is defined as hazardous waste as it contains some heavy metals.

We conducted tests in an innovative cyclone solution for cost-effective drying and separation of the heavy metals.

The result of the tests will be used to look at a more optimal utilization of hazardous waste and potentially also a reduction in landfill needs.

Elkem

Recycling of plastic materials

A customer had a target to produce small bottles of polyethylene (HDPE) with a content of 50% recycled HDPE from household waste.

Norner carried out a pre-project to find possible sources for recycled HDPE and evaluate the relevant recycling companies who offer such materials.

In the second stage, Norner carried out a pilot test program for extrusion of bottles. The bottles were tested for relevant quality parameters like processability, stability and purity together with functional properties. The results led to an approved material.

norner™
The Polymer Explorers

Materials for extractive media

The plastic inner liner in the process equipment at the CO_2 capture technology centre at Mongstad did not have enough chemical resistance to the aggressive environment.

A combination of extraction of additives, harsh chemicals and high temperature was the root cause of the problems, resulting in a too short lifetime of typically 5–10 years.

Norner tested and demonstrated the weakness followed by a development which resulted in a novel additive formulation securing the process equipment an extended lifetime of up to 25 years.

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The Polymer Explorers


Ocean
Sun

Weather resistant materials development

Ocean Sun has developed a solar technology that utilize coastal seawater, lakes and reservoirs.

Norner supports in selecting, developing and testing the optimal polymer membrane solution.

Membrane challenges:

- Strong enough to carry the loads of the modules and withstand the waves.
- Exposure to sun light, water, heat and marine algae.

The project involves testing in UV and climate chambers to demonstrate 20 years lifetime.

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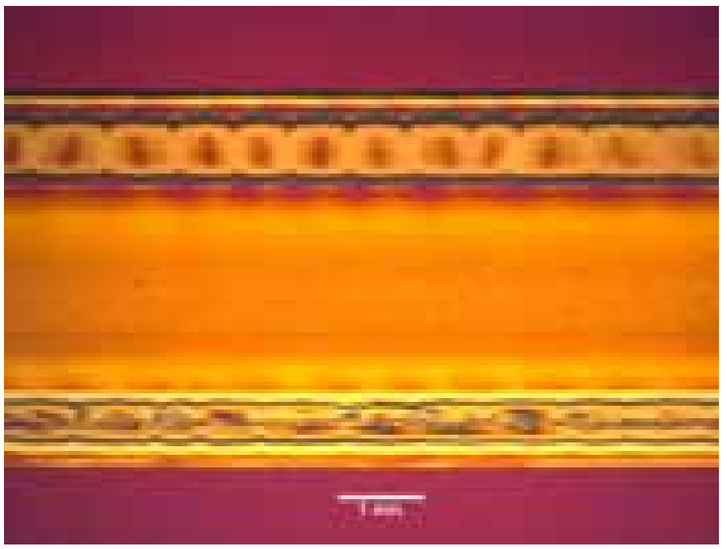

Investigation of skin-core morphology by microscopy.

Development of container for dangerous goods

During the development of a container for dangerous goods, Mezonic encountered material challenges and problems to fulfil the required test regime.

Mezonic came to Norner for their high competencies, material understanding, processing and for doing failure analysis by microscope.

Analyses and advice resulted in the container obtaining certification for the highest class of UN-testing for packaging of dangerous goods.

Norner's advice is to include product examination in the initial design phase, to avoid delays and high costs at later stages.

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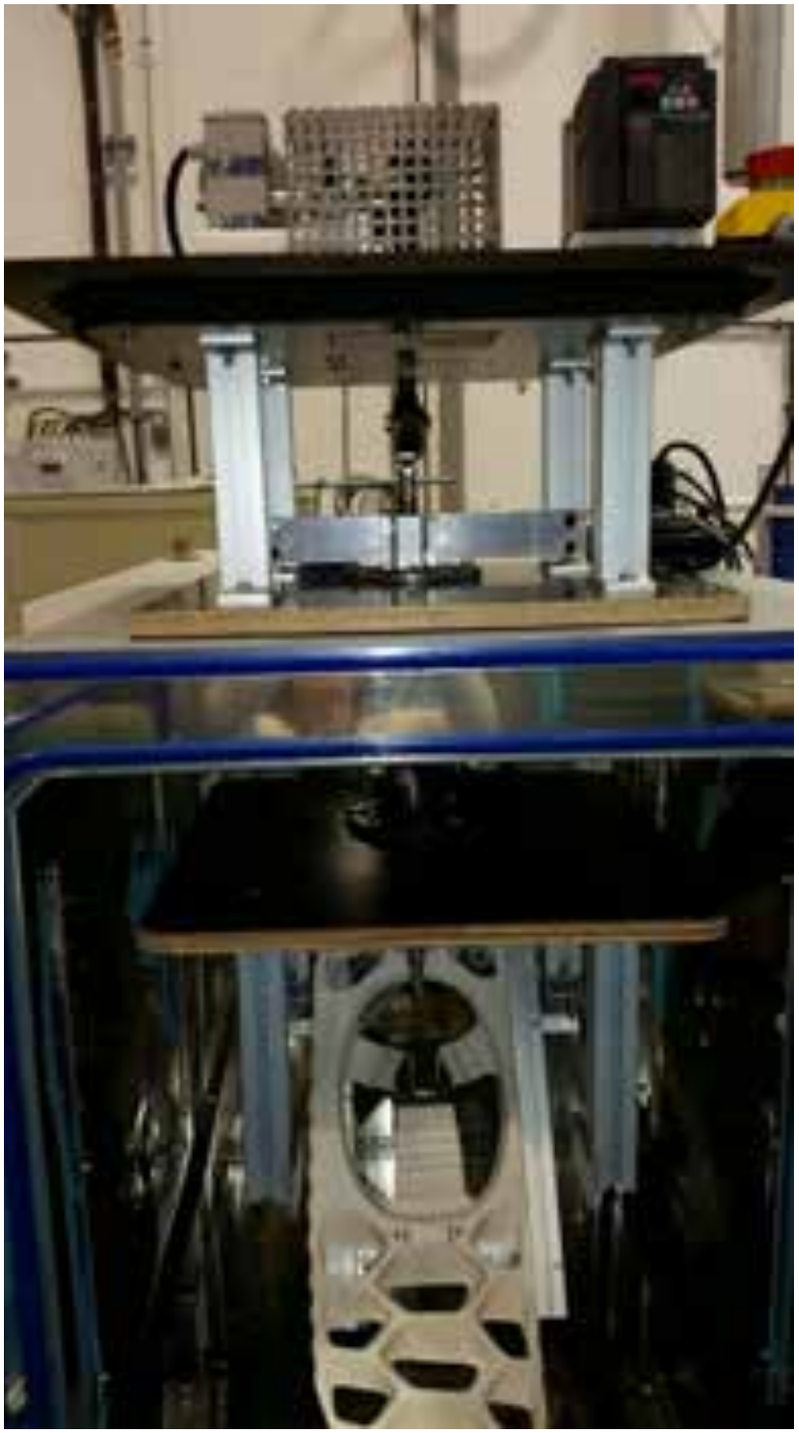

Functional test of snowshoe

The military in Canada is operating in demanding weather conditions with very low temperatures.

In this project we provided a functional test of snowshoes of different kind of materials.

We re-designed a climate chamber and placed a test jig inside, designed and constructed by us for this specific test to simulate an armed soldier walking with the snowshoe.

Snowshoes of different types of materials and design were then tested for more than 50,000 steps in a temperature of -57˚C.

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Standard sample
before testing

After exposure of
ammonia for 14 days

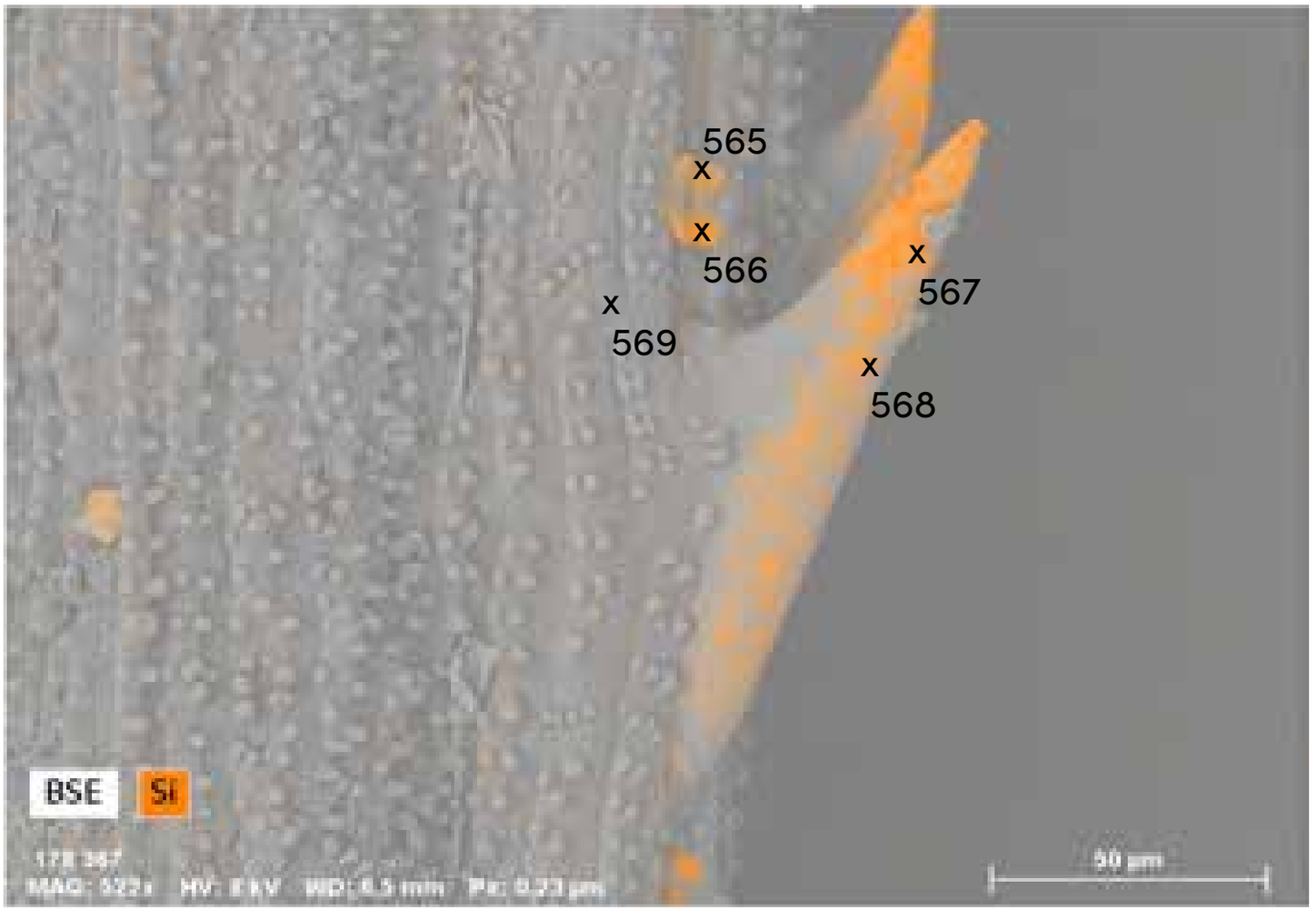
After 96 hours in
salt mist chamber

Aging in ammonia and salt mist

This valve shall be used in an environment with exposure to both ammonia and salt spray, and our customer wanted to test whether the choice of material for the valve is suitable for these conditions. The requirement is less than 2.5 % rust after completion.

The valves were placed in ammonia for 14 days at 25°C (with pressure of approximately 4 bar) and then in salt mist for 96 hours (35°C and 5 % saline).

After exposure of ammonia and salt mist the valves were inspected carefully. The test results showed little or no rust after ammonia exposure, but severe rust attack after exposure to salt mist.



Atomic concentration [%]

Spectrum	Carbon	Oxygen	Silicon	Potassium
565	60.70	18.89	20.14	0.27
566	46.20	39.23	14.57	
567	30.62	15.01	54.37	
568	32.11	18.78	49.10	
569	86.47	13.44		

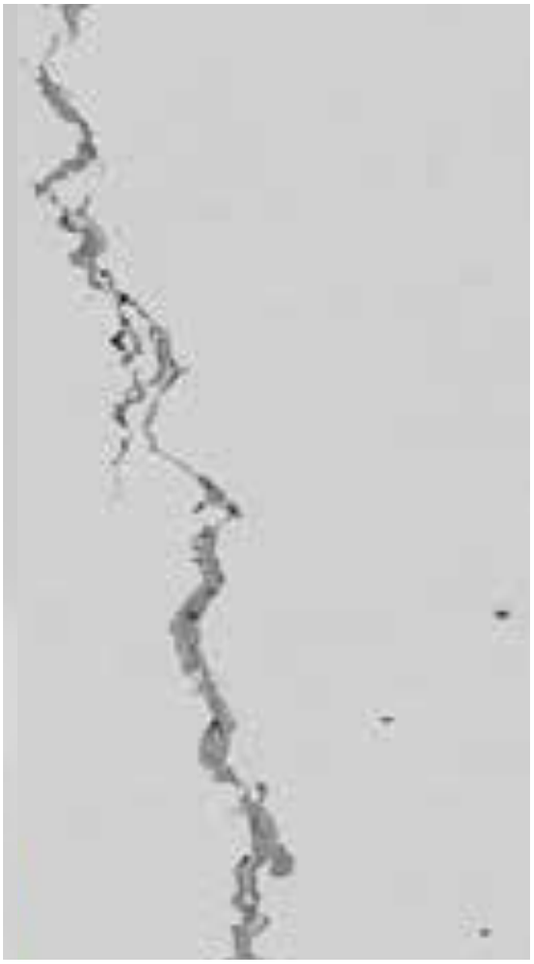
Material analysis with a SEM

HØST is using an Elkem Microsilica® based product (silica fume) in fertilizers, and they needed to prove that the fertilizer actually is absorbed by the plant.

The microsilica based product makes the plants more resilient against drought and rice blast fungus.

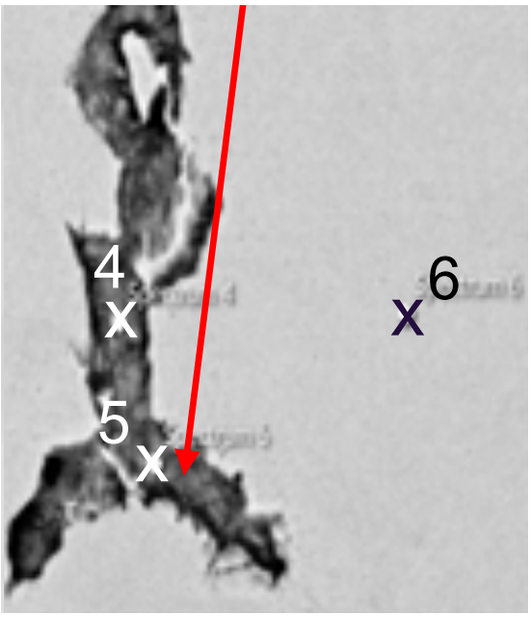
Elkem used a scanning electron microscope (SEM) and their industrial expertise in microsilica and material analysis to document that the silicon is absorbed, transported and positioned in the rice leaves.

Elkem



Result Type	Weight %

Spectrum Label	Spectrum 4	Spectrum 5	Spectrum 6
O	26.01	23.13	
Si	0.32	0.29	0.22
Ca	0.14	0.14	
Cr	0.69	0.61	2.55
Mn	0.39	0.36	0.79
Fe	67.82	70.25	94.02
Ni	1.20	1.32	2.04
Zn	3.43	3.89	
Mo			0.38
Total	100.00	100.00	100.00



Failure analysis of stud bolt with cracks

Elkem received a sample for examination in a scanning electron microscope (SEM). This particular bolt was known to have cracks in the thread roots.

The analysis discovered two visible cracks in the root referred to as “Root 1” in the picture. The longest crack was approximately 370 microns.

In the bottom of the crack we found evidence of zinc (Zn) and oxides (O). Zink in the bottom of crack indicates that the bolt was fractured before galvanizing, therefore not during torqueing of the bolt.

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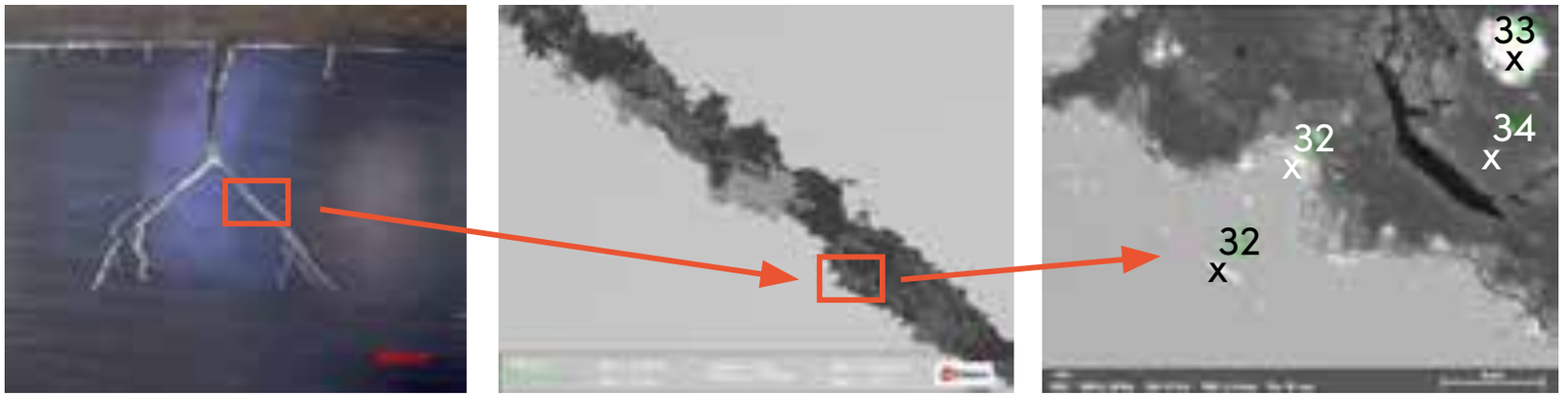

Normalized mass concentration [%]

Spectrum	Carbon	Nitrogen	Oxygen	Sodium	Silicon	Sulfur	Chlorine	Iron	Zinc	Gold	Lead
31	0.00		3.48		0.39	4.78		23.29	9.85	0.00	58.21
32	0.00		1.74	2.62				37.91		0.00	57.73
33			5.70					3.76		0.00	90.54
34		7.89	39.74	3.70			3.49	16.24		0.00	28.95

Failure analysis of steel vessel

A six centimetres long crack was detected on top of a steel vessel from a calcining kiln. It contained cooled water and the kiln is placed in hot and carbonaceous surroundings.

The analysis proved that the cracks contained lead and zinc. Lead (Pb) is known to cause stress corrosion cracking (SCC) in the steels.

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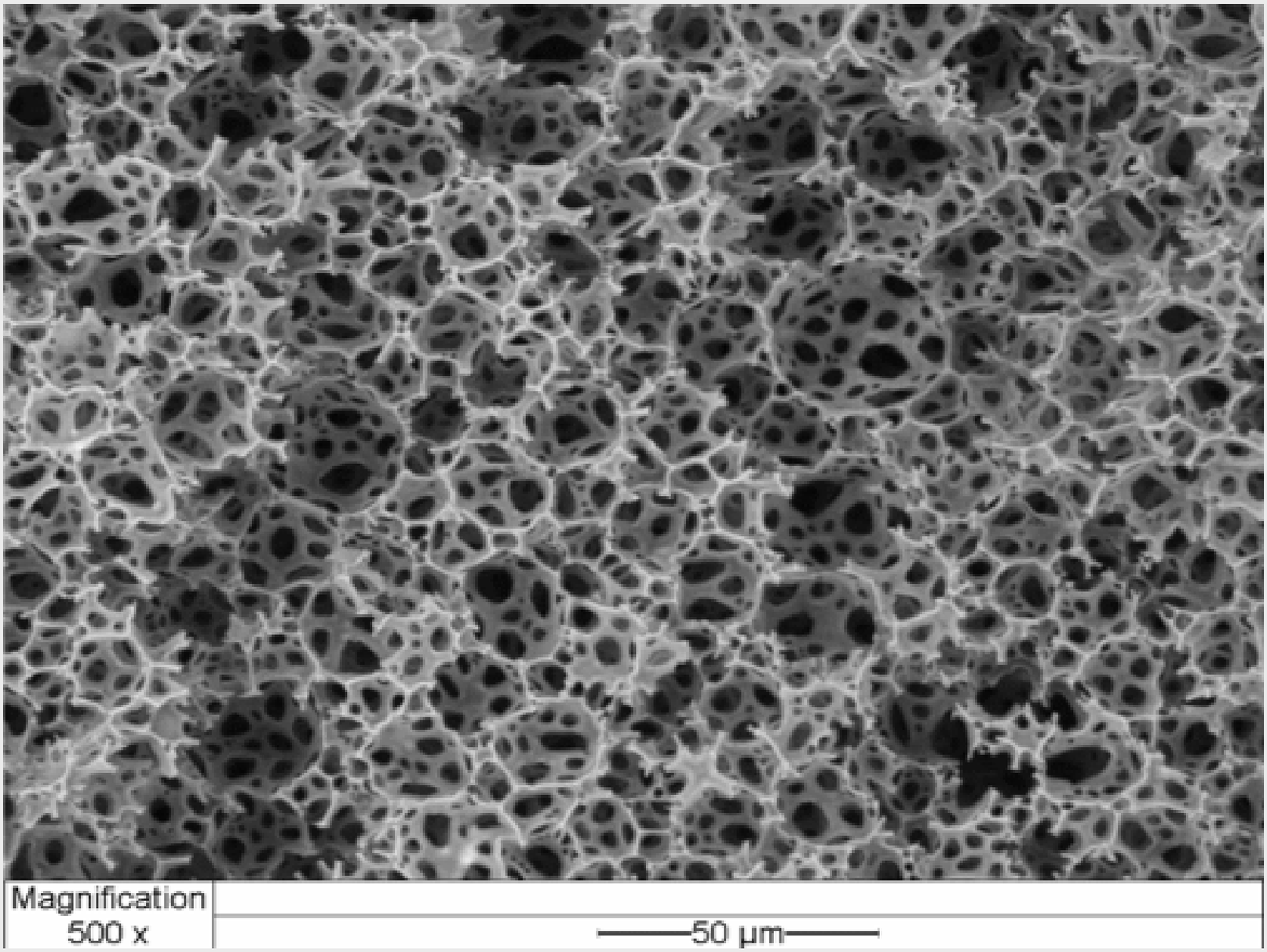
Magnification
500 x
50 µm

Project period 2009-2011

HIP Super-insulating materials

Funded by the European Union

The transport sector has high demands from their customers to minimize the degradation of goods during transportation.

Norner developed a process which can produce high internal phase emulsion (HIPE) materials with close control of porosity and pore size distribution.

The new material reached porosity above 90% and pore size <1µm, is lighter and has better insulation characteristics than traditional thermoplastics used for insulation.

This project has received funding from the European Union's 7th Framework Program (FP7).

norner™
The Polymer Explorers

Project period 2015-2018

PRESERVIA – Preserve world heritage

The Research Council of Norway

When the Vatican Library needed a digital archive to preserve > 80,000 manuscripts for future generations they chose Piql's technology. Piql's innovative approach is to utilise photosensitive film as a digital medium based on high density QR codes.

As their R&D partner, Norner has contributed to the development and verification of the durability and lifetime of all elements of this specially developed storage medium including design for a protective packaging. This includes several funded research projects.

This project was supported by The Research Council of Norway.

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ReSiTec
SINTEF
INKRON
SOLSTEK
imec
Fraunhofer
PV CYCLE
ECM
TU WIEN
ines
FerroAtlántica
PYROGENESIS S.A

Project period 2015-2018

CABRISS

Funded by the
European Union

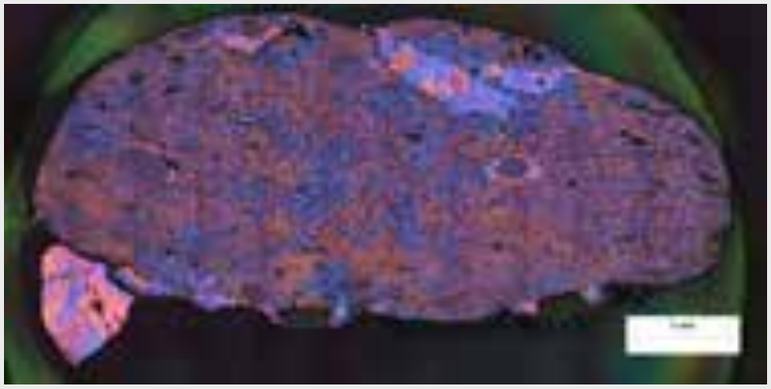
The main vision of CABRISS project is circular economy for solar panels where valuable materials such as indium, silicon and silver are used to create new solar cells and for other products.

The project aimed at pioneering a circular economy dedicated to handle the critical situation of recycling the important amount of photovoltaic waste and benefiting also to electronics, metallurgy and glass industries.

This project has received funding from the European Union's Horizon 2020 research and innovation programme.

ReSiTec lead the work package on purification of silicon recovered in photovoltaic wastes.

ReSiTec



Project period 2016-2018

Waste2Value

The Research Council of Norway

Waste2Value was a sustainability project in the process industry where side streams were processed to products, or upgraded to raw materials for the industry itself.

The goal was to develop innovative, cost-effective solutions for the process industry, which focused on industrial symbiosis and integration into existing infrastructure. A broad screening of opportunities, contact with potential users and flexible treatment methodology based on different customer requirements are among the most important deliverables in the project. The project has laid a robust foundation for further work on these side streams.

This project was supported by The Research Council of Norway.

Elkem ReSiTec


Waste
Pilot
REE4EU
New product


Angus Special Metals
LCM
Boston
SINTEF
TMS Conference
Chicago
SINTEF
13° WS on Reactive
Metal Processing (MIT)
SINTEF
TMS Conference
San Diego
Phoenix
AVERE
Honda Meeting
Kobe
Kyoto
KIFEE
Tokyo
AVS31
SINTEF
AVERE
cefic
SusChem
Brazil
Cape Town
INFACON
Elkem

Project period 2016-2018

REE4EU

Funded by the
European Union

Rare-earth elements (REEs) are the seventeen chemical elements lanthanides, Scandium and Yttrium. REEs are considered “key-enablers” of green technologies, as they are used in hybrid electric vehicles, windmills and highly efficient electric engines.

Regaining REE from RE-containing waste streams could constitute an important RE secondary source in Europe, increasing our independence from imports.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme.

Elkem performed the up-scaling of the processes.

Elkem

Particles from sculls 0-6 mm, a mix of slag and silicon.
The white particles are probably undissolved silver sand.

Project period 2017-2019

ReSirkSi

In this project we aimed at separating oxides from Silicon, to return the valuable metal to the process.

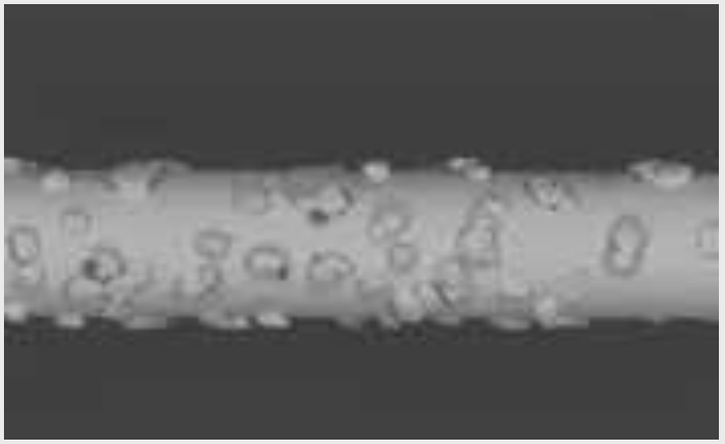
Trials were performed on both traditional and innovative separation technologies, where process complexity, cost and product purity were the main focus.

In-spec quality was obtained by several methods, enabling the customer to choose the solution that fit best with their existing process setup and infrastructure.

This project was supported by the Regional Research Fund Agder.

Elkem ReSiTec

ReSiTec silicon kerf from diamond wire sawing



Diamond wire (SEM image)

Silicon kerf (SEM image)

Project period 2018-2020

SELISI

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Program for Research and Innovation

The carbon footprint of solar cells can be lowered by recycling the silicon lost during the different production steps of the photovoltaic panels. During the solar cells wafer cutting operation, 40 % of the silicon gets lost. The dust generated is called Si-kerf and is currently not yet recovered.

The project aims at recycling and purifying this kerf for its re-use in the Si-based ceramic and photovoltaic industries, by making silicon ingots up to 100% recycled Si-kerf.

This project has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

ReSiTec


ic tour
Nissan LEAF
10
laminated

Project period 2019-2021

LIBRES

The Research Council of Norway

The use of lithium-ion batteries (LIB) has sharply increased over the last years and further growth is expected. This is mainly driven by the demand for electrical vehicles in the short term, and for stationary and marine applications in the longer term.

The batteries contain valuable materials such as lithium, cobalt, nickel, copper, aluminium, graphite and special fluoride salts. When the batteries reach the end of their life, there is a great potential for recycling to recover these materials.

This project is supported by The Research Council of Norway's program ENERGIX.

Elkem

UiA University of Agder


TEKNA
Tek-15

Project period 2020-2023

MADAM

The Research Council of Norway

MADAM is a 4-year project which aims to develop new products and production processes for Silicon-based alloys tailor-made for powder-based Additive Manufacturing (AM).

Based on advanced numerical models to simulate the powder production processes and extensive experimental studies, novel and innovative metal powder alloys will be developed. National facilities relevant to powder production and AM at Future Materials Norwegian Catapult Centre will be extensively used for reaching project goals.

This project is supported by The Research Council of Norway.

ARENDALS FOSSEKOMPANI

Elkem

UiA University of Agder

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