



SCIENCE LINK

REPORT OF ESTABLISHED COOPERATION

Krakow / 2014

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INTRODUCTION

The Science Link project aims to support and encourage innovation and entrepreneurship in the Baltic Sea Region. A main task is to improve the interaction between commercial customers and existing research infrastructures (RIs) and to relate the service at RIs to the needs of commercial users by creating good conditions.

Science Link is a network between leading research infrastructures (RI) of photon and neutron sources and their users. Apart from the research infrastructures, the network also includes scientific institutes, universities and regional organizations that serve as service and promoting units. Science Link offers companies the opportunity to investigate a current R&D issue by using state of the art scientific analysis at Europe's leading neutron and synchrotron research infrastructures. The resources offered to the companies by Science Link are access to the four major neutron and synchrotron facilities in the Baltic Sea Region, which are DESY, HZG, HZB and MaxLab, and support by universities, scientific partners and governmental organizations. The offer also includes consultation, support and assistance before, during and after the analysis.

In the start configuration, SCIENCE LINK includes the large-scale Research Infrastructures in the area of neutron and photon science (DESY, HZG, HZB, MAX-lab, PNPI) in the Baltic Sea Region. They offer measurement opportunities, training and consultation. Universities (Roskilde, Lund, Turku, Tartu), Institutes (Institute of Solid State Physics University of Latvia (LV), Semiconductor Physics Institute of Center for Physical Science and Technology (LT), Institute of Physics, Polish Academy of Science (PL), and regional or business development agencies (Invest in Skåne (S), Kainuun Etu (FI), Tartu Science Park Foundation (EE), Valsts reģionālās attīstības aģentūras (LV), Rīgas Domes Pilsētas Attīstības Departaments (LV), Mokslo, inovacijų ir technologijų agentūra (LT), Fundacja Inicjatyw Innowacyjnych (PL)) act as regional contact points offering consultation and information. Regional authorities assisted by the public authorities for Science and Education will support regional dissemination and secure further cooperation after completion the project.

In addition to a study at the suitable research facility the offer also includes consultation, support and assistance before, during and after the analysis. Experts from the research fields within the network will provide you with:

- Consultations via the Science Link contact points and experts from local universities and scientific institutes on the matters of the R&D work to be done
- Support in the preparation and performance of experiments at the research facilities
- Assistance with data analysis and interpretation of the result

1. SCIENCE LINK STRUCTURE AND PARTNERSHIP COMPOSITION

- 1 DESY, Hamburg
- 2 Helmholtz-Zentrum Berlin für Materialien und Energie GmbH
- 3 Helmholtz-Zentrum Geesthacht Zentrum für Material und Küstenforschung
- 4 Kainuun Etu Oy
- 5 University of Turku
- 6 Tartu Science Park Foundation
- 7 University of Tartu
- 8 Institut of Solid State Physics University of Latvia
- 9 State Regional Development Agency, Riga
- 10 Riga City Council, City Development Department
- 11 Agency for Science, Innovation of Technology, Vilnius
- 12 Semiconductor Physics Institute of Center for Physical Science and Technology, Vilnius
- 13 Institute of Physics, Polish Academy of Science, Warsaw
- 14 Foundation of Innovative Initiatives, Krakow
- 15 Invest in Skane, Malmö
- 16 University Lund, Max-lab, Lund
- 17 Technical University of Denmark, Roskilde
- 18 Petersburg Nuclear Physics Institute [Associated Partner]

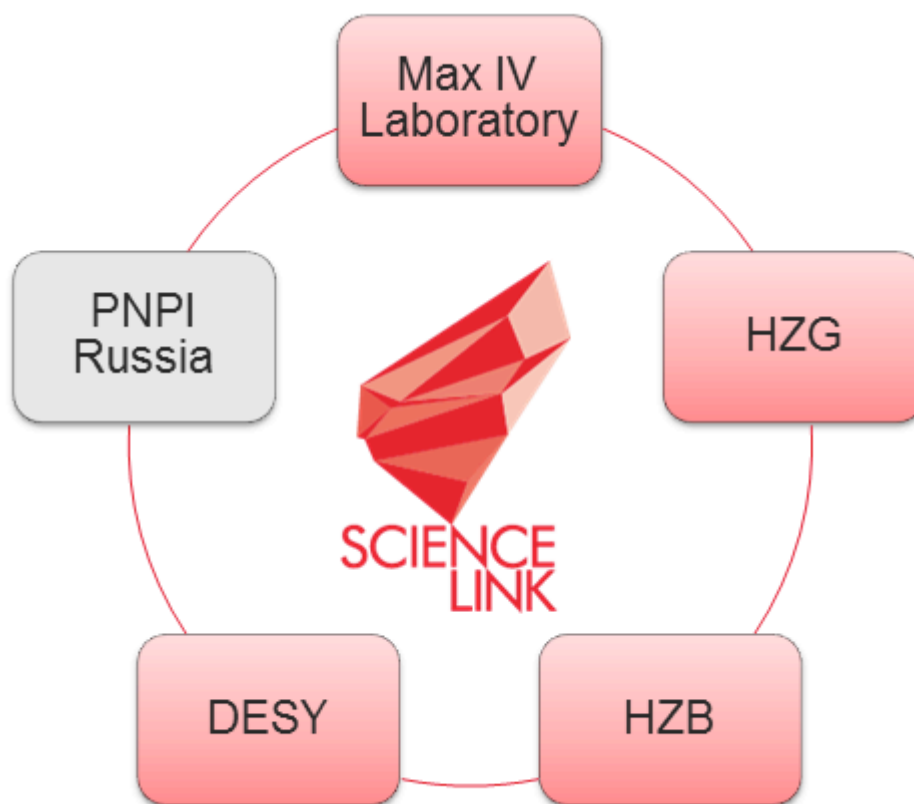


List of partners:

1. DESY Deutsches Elektronen Synchrotron – Hamburg – DE
Type: Research Infrastructures
Representative: Uwe Sassenberg
2. Helmholtz-Zentrum Berlin für Materialien und Energie GmbH – Berlin – DE
Type: Research Infrastructures
Representative: Walter Braun

3. Helmholtz-Zentrum Geesthacht Zentrum für Material und Küstenforschung – Geesthacht – DE
Type: Research Infrastructures
Representative: Walter Braun
4. Kainuun Etu Oy – Kajaani – FI
Type: Other public equivalent body
Representative: Ninetta Chaniotou
5. Turun Yliopisto – Turku – FI
Type: Academic / Scientific organization
Representative: Ari Koski
6. Tartu Teaduspark – Tartu – EE
Type: Other public equivalent body
Representative: Neeme Kärbo
7. Tartu Ülikool – Tartu – EE
Type: Academic / Scientific organization
Representative: Marco Kirm
8. Latvijas Universitātes Cietvielu fizikas institūts – Rīga – LV
Type: Academic / Scientific organization
Representative: Andis Sternberg
9. Valsts reģionālās attīstības aģentūras – Rīga – LV
Type: National public authority
Representative: Līga Baltina
10. Rīgas Domes Pilsētas Attīstības Departaments – Rīga – LV
Type: Local public authority
Representative: Normunds Strautmanis
11. Mokslo, inovacijų ir technologijų agentūra – Vilnius – LT
Type: National public authority
Representative: Nattalija Koseleva
12. Fizinių Ir Technologijos Mokslų Centro Puslaidininkių fizikos institutas – Vilnius – LT
Type: Academic / Scientific organization
Representative: Sigitas Mickevicius
13. Instytut Fizyki Polskiej Akademii Nauk – Warsaw – PL
Type: Academic / Scientific organization
Representative: Krystyna Jablonska
14. Fundacja Inicjatyw Innowacyjnych – Krakow – PL
Type: Non-governmental and non-profit registered association
Representative: Piotr Piwowarczyk
15. Invest in Skåne – Malmö – SE
Type: Regional public authority
Representative: Stefan Johansson
16. Lunds Universitet – Lund – SE
Type: Academic / Scientific organization
Representative: Anette Orheim
17. Danmarks Tekniske Universitet – Roskilde – DK
Type: Academic / Scientific organization
Representative: Martin Meedom Nielsen

Research Infrastructures



The Research Infrastructures provide knowledge transfer and customized training to new commercial users. RI are going to spend beam time, that can be seen as the bottleneck at RI, and service to the Science Link project enabling potential commercial users to carry out first tests and feasibility studies.

Deutsches Elektronen-Synchrotron

- Hamburg and Zeuthen, Germany
- Offers a broad research spectrum of international standard focusing on three main areas: accelerator development, photon science and particle physics.
- Visited by more than 3000 scientists from over 40 countries every year.



Helmholtz-Zentrum Berlin für Materialien und Energie


- Berlin, Germany
- Operates two scientific large-scale facilities, using both neutrons and ultra-bright photon beams ranging from Terahertz to hard X-rays.
- One of the few centres in the world that offers the whole range of instruments for neutron and synchrotron radiation within one laboratory structure.



Helmholtz-Zentrum Geesthacht

- Geesthacht, Germany
- Is engaged in long-term activities in the fields of materials research, coastal research, and regenerative medicine.
- The German Engineering Materials Science Centre (GEMS), part of HZGs, provides an infrastructure for complementary research with photons and neutrons.

 Helmholtz-Zentrum
Geesthacht
Zentrum für Material- und Küstenforschung

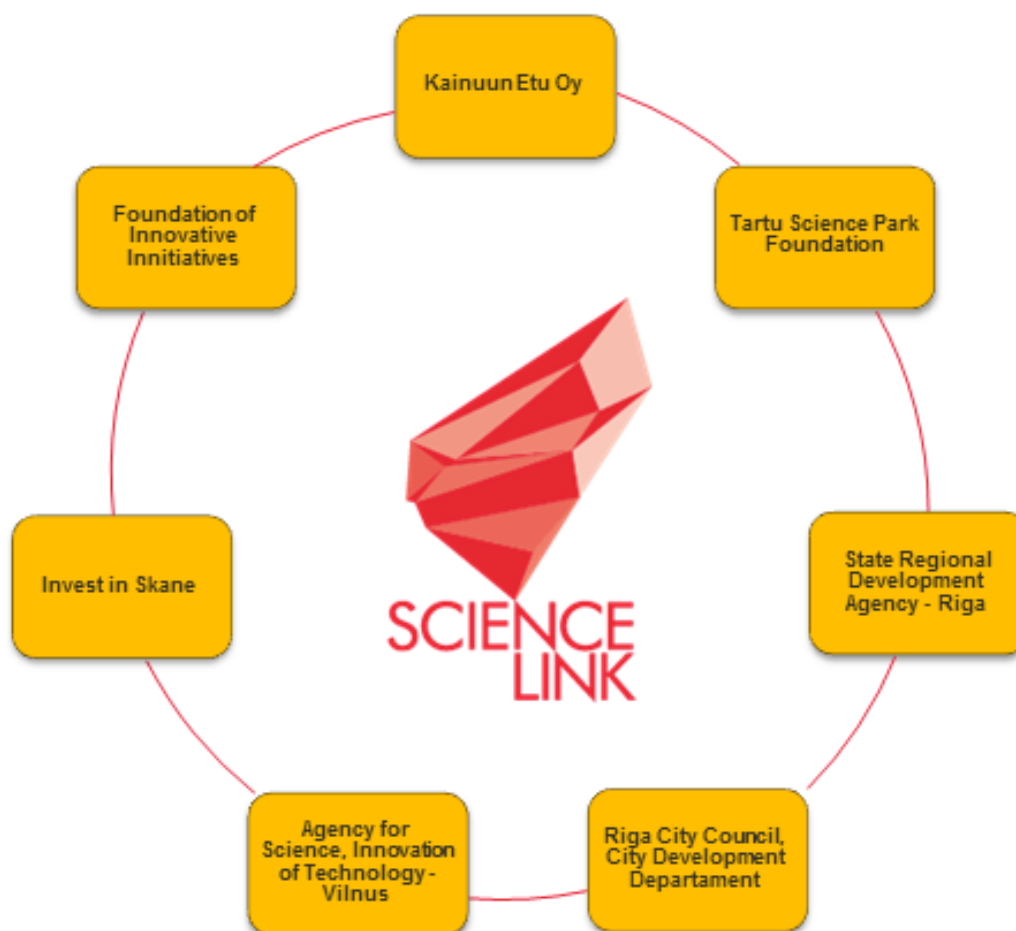

German Engineering Materials Science Centre

MAX IV Laboratory

- Lund, Sweden
- Covers disciplines such as physics, chemistry, biology, materials science, geology, engineering and medicine.
- Visited by more than 800 researchers.
- The new MAX IV facility will be the world's brightest storage ring-based light source.

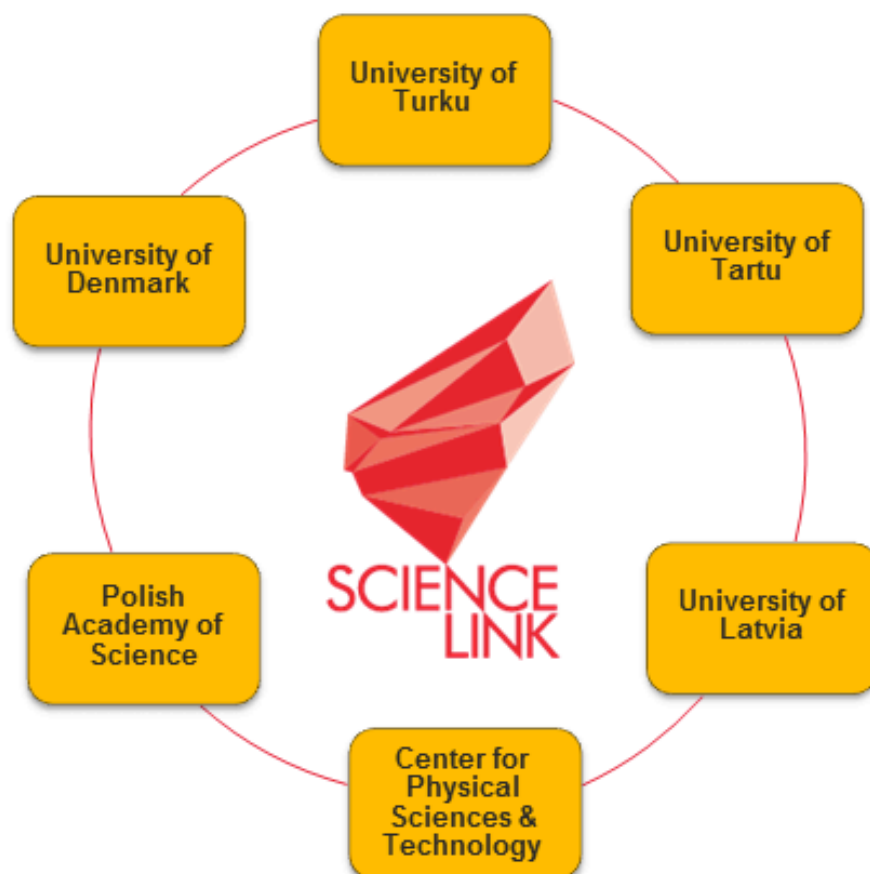

LABORATORY

Regional Partners



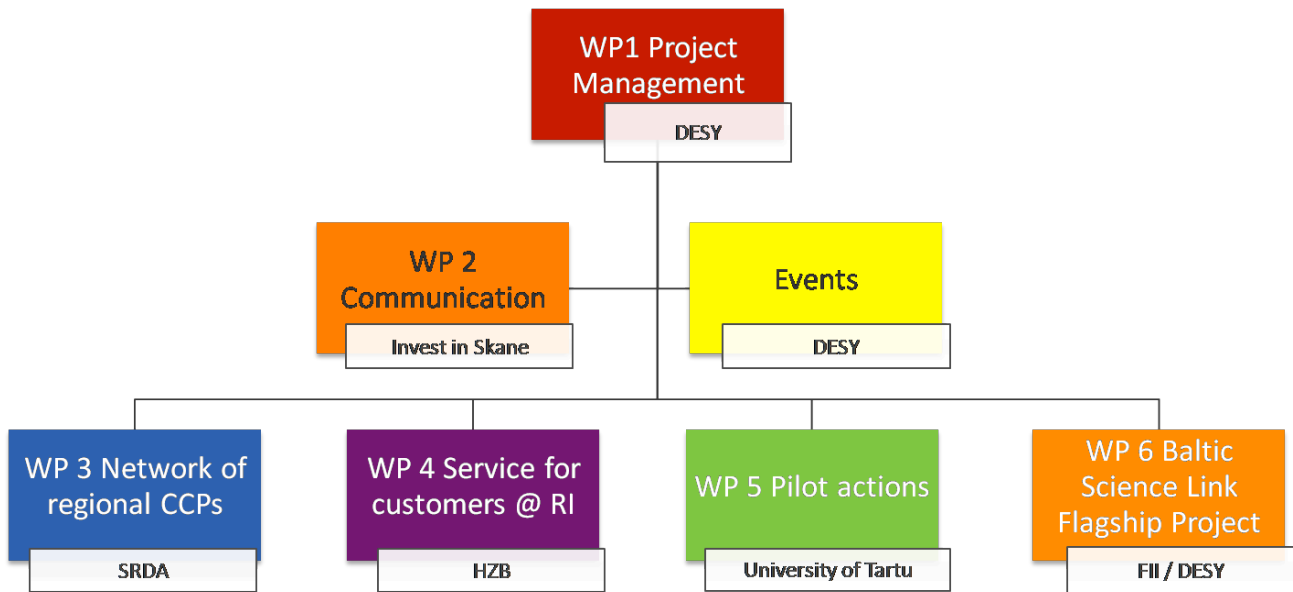
They know, as regional development agencies, innovation agencies or business parks, requirements of potential commercial users in the regions and can effectively promote innovation and support medium-sized companies. These Partners will operate the Contact Points in cooperation with a Scientific Partner.

Scientific Partners

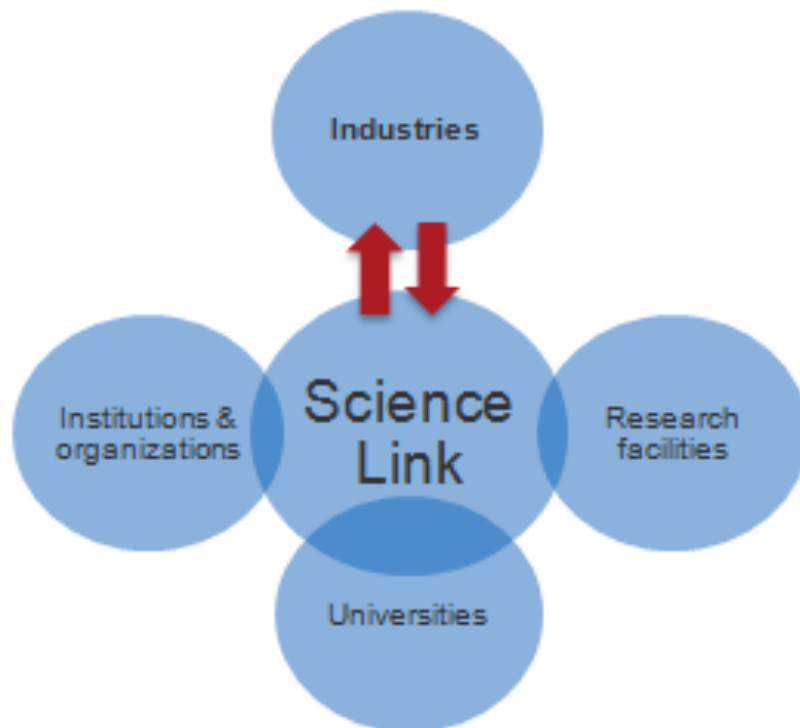


Scientific Partners coming from each country of the BSR, except Norway, are responsible to advice and inform the Regional Partners at the Contact Points. All Scientific Partners have established cooperation with Research Infrastructures.

PROJECT ORGANIZATION CHART

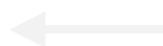


SCIENCE LINK STEAKEHOLDERS

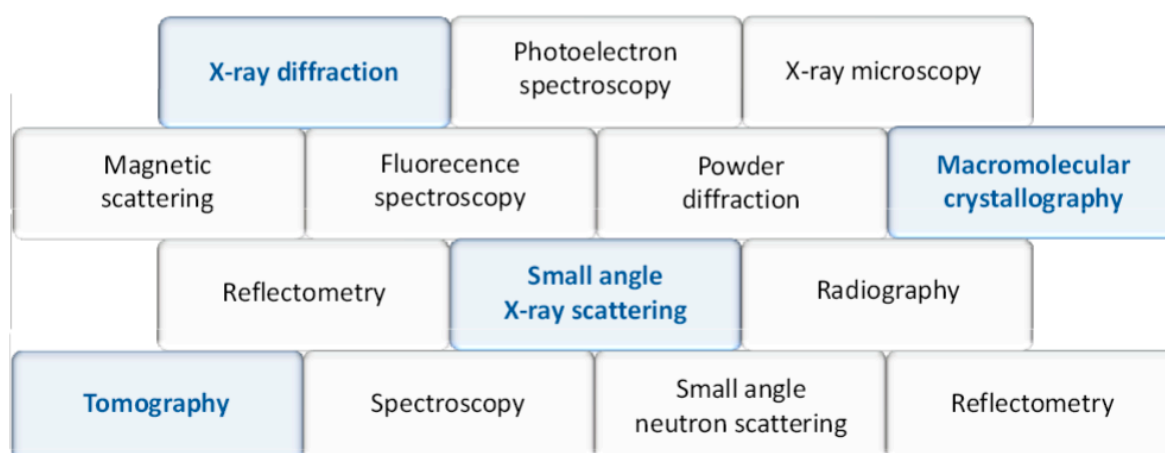


SCIENCE LINK CONTACT & CONSULTATION POINTS





2. MAPPING OF ESTABLISHED COOPERATION



The project has strategic relevance by offering outstanding experimental opportunities to the commercial sector, including SMEs. The main sectors of application potentially addressed by direct use of the aforementioned European large-scale RI are:

❖ Agriculture and Food Science

Production of crops with resistance to disease and cold will result in longer crop seasons and greater yields, while detoxification of soil and purification of water will mean that currently unusable soil can become viable. Furthermore, understanding of aging processes in foods can result in longer shelf-lives which will help when shipping food to famine stricken lands.

Science Link offers Agriculture and Food-Science companies in the Baltic Sea Region access to experimental techniques applicable to a range of problems including:

- Analysis of soil
- Characterisation of trace-element distribution in plants
- Characterisation of structure and function of plant proteins
- Imaging of plant structures and mapping cellular constituents
- Studying the effects of fertilisers and contaminants on plants
- Investigation of the processes occurring when germs weaken host plants
- Assessment of the role of root-soil-microbe communication

- Understanding and slowing down of ageing processes in food

The experimental techniques available include:

- Diffraction methods
- X-ray absorption spectroscopy
- Small-angle X-ray and neutron scattering
- X-ray and neutron tomography
- Synchrotron Infrared spectroscopy

❖ **Chemicals**

Chemical companies are constantly developing novel or refined chemicals for use in home products or by other industrial sectors. The development is enabled by research into the fundamental properties of matter and for this purpose chemical companies need access to sophisticated instruments and methods.

Science Link offers chemical companies in the Baltic Sea Region access to experimental techniques applicable to a range of problems including:

- Stress-strain analysis for metallurgy and plasturgy
- Characterisation of the molecular and microstructures of plastics
- Understanding catalytic reactions for new catalyst development
- Research and development of new fine chemicals
- Chemical and structural characterisation of powders, colloids and nanomaterials

The experimental techniques available include:

- X-ray and neutron single crystal diffraction
- X-ray absorption spectroscopy
- X-ray and neutron powder diffraction
- Small angle X-ray and neutron scattering
- X-ray nanotomography

❖ Environment and Energy

Even in conventional power plants (and especially nuclear ones) many effects reducing the lifetime of components and therefore the efficiency are not fully understood. Intense research is required in the development of devices for alternative energies like solar cells or fuel cells and in the exploration of energy storage and transport systems. Here materials allowing for high energy density combined with light weight are required. Neutrons and synchrotron radiation offers the opportunity to investigate material properties that are of importance within usage, supply, conversion and storage of energy.

The analytical techniques can be applied in research within environmental, energy, clean and green technologies. Neutrons and X-ray beams can be used in a broad range of measurements spanning from structural characterization of fibre materials under stress and strain in wind turbines to the monitoring of micro- and nanoscale structure of fuel cell components during their functioning.

Essentially, a study of structure and properties of a material or technology can lead to an optimization that may reduce emission of greenhouse gases and other pollutants, improve the efficiency in the use of resources and thereby also provide a potential reduction of financial costs.

Science Link offers the companies the opportunity of accessing experimental facilities that may shed further light on a range of environmental and energy-related issues. To mention some:

- Functioning and stability of solar panels
- Low energy lightning, cooling and heating devices
- Structure of materials for thermal insulation
- Friction reduction and hardening of surfaces
- Light-weight construction materials
- Improved efficiency of propulsion techniques
- Study of catalysts in industrial processes
- Micro and nanoscale structure of biopolymers and composite materials

- Study of processes and materials for reduction and recycling of waste

The available experimental techniques include:

- Time resolved X-ray and neutron diffraction
- X-ray absorption spectroscopy
- X-ray fluorescence spectroscopy
- Small angle X-ray and neutron scattering
- High resolution and phase contrast enhanced X-ray and neutron imaging
- X-ray nanotomography
- X-ray and neutron reflektometry

❖ Home and Personal Care

Many challenges within modern Home- and Personal Care technology can be addressed by using synchrotron and neutron radiation techniques. Complex molecules used as thickeners or other additives and their behaviour in cosmetic formulations can be characterised. By scattering methods, one can obtain valuable data about the organisation of micellular, vesicular and lamellar structures in detergent formulations such as silicone shampoos and emulsions.

Science Link offers Home and Personal Care companies in the Baltic Sea Region access to experimental techniques applicable to a range of problems.

- Analytics on macromolecules
- Examination of self assembly in formulations (micellular, vesicular or lamellar structures)
- In-situ investigation at temperature dependent behaviour, stability and ageing of formulations or ingredients
- Monitoring of the effects of cosmetics on the molecular structure of skin, fingernails and hair
- Insights on rheologic activity of emulsions or rheology modifiers

The experimental techniques available include:

- X-ray and neutron diffraction
- X-ray absorption spectroscopy
- X-ray fluorescence spectroscopy (XRF)
- Small angle X-ray and neutron scattering (SAXS)
- Grazing incidence small angle X-ray scattering (GISAXS)
- X-ray and neutron reflektometry

❖ Life Science and Biotechnology

Life science and Biotechnology companies are among the most frequent industrial users of synchrotron and neutron facilities. The techniques available allow investigation and development of tailor-made biomolecules, biomaterials and biocompatible materials for use in their novel products, e.g. drugs, Lab-on-a-chip devices, and biomechanics.

Science Link offers Life Science and Biotechnology companies in the Baltic Sea Region access to experimental techniques at the partner synchrotron and neutron facilities applicable to a range of problems including:

- Protein structure
- Drug characterisation and the development of novel pharmaceuticals
- Polymorphism diffraction
- Distribution of elements in biomaterials
- Organic product identification and diffusion of products
- Tomography of biomechanical components

The experimental techniques available include:

- Protein crystallography
- X-ray absorption spectroscopy
- X-ray and neutron powder diffraction
- Small angle X-ray and neutron scattering

- X-ray and neutron reflektometry

❖ **Materials Science and Nanotechnology**

The understanding of functional properties of materials is essential for their continuous development and improvement. Facing energy and environmental challenges, industrial companies more than ever have strongly invested in materials development. By using synchrotron and neutron radiation, information about materials structure and properties on different length scales extending from nano- to macroscopic dimensions can be obtained non-destructively.

Some examples of common techniques for material characterization are diffraction, small-angle scattering and tomography methods. The application of these techniques paves the way for a deeper understanding of the structure of materials as well as the associated mechanical, thermal, electrical and optical properties.

Science Link offers companies within Material Science and Nanotechnology access to experimental techniques applicable to a range of problems including:

- Nano-particles characterisation (self- assembly of nanoparticles, large clusters)
- Residual stress and strain analysis
- Chemical and phase analysis in novel materials
- Functionality of applied materials
- Coatings and thin films characterisation
- Earth science and related materials
- Crystallography
- Tomography for 3D characterisation
- Investigation of catalysis processes

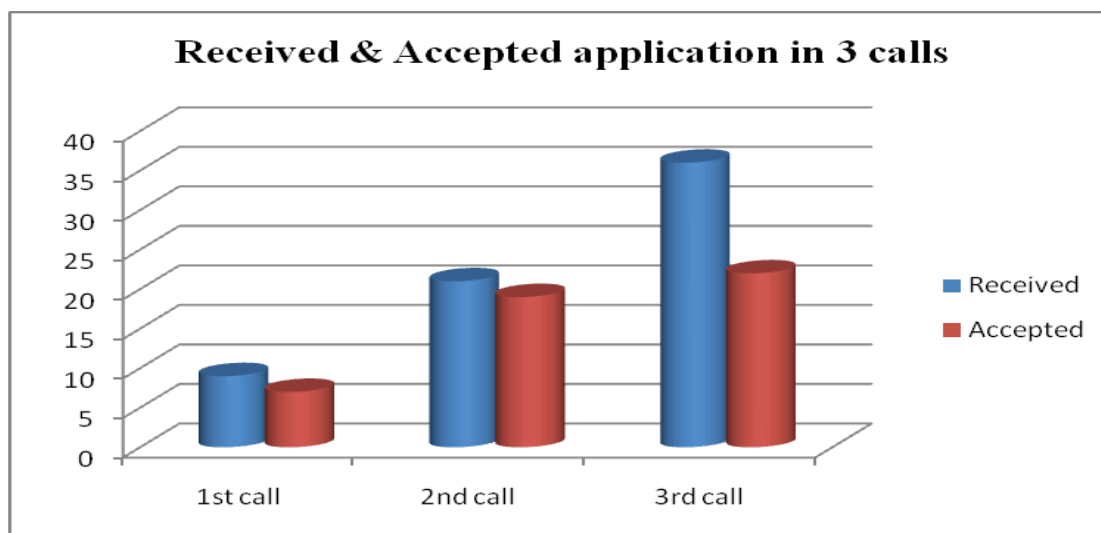
The experimental techniques available include:

- X-ray and neutron diffraction
- X-ray absorption spectroscopy

- X-ray fluorescence spectroscopy
- Small angle X-ray and neutron scattering
- X-ray and neutron tomography
- X-ray and neutron reflectometry

Science Link announced three calls for proposals during the project period 2012-2014. It offers the opportunity to use some of the leading large-scale facilities (LSF) providing synchrotron radiation and neutrons for R&D. The studies performed at the facilities were free of charge and were within the framework of the Baltic Sea Region program.

The project Science Link supports industrial research by enterprises at large scale research infrastructures in the Baltic Sea Region. The goal of the project is to create awareness of the possibilities offered at research facilities in the region and show how R&D at these sites can contribute to innovation within the industry. The long term goal is to contribute the economic growth within the region.



This offer was relevant for various industries including pharmaceuticals, biotechnology microelectronics, chemicals, plastics, home and body, transportation, building materials, food, and the environment industries. In addition to a study at the facility the following is included:

- Consultations via the Science Link contact points and the local universities on the matters of R&D work to be done.

- Support in the preparation and performance of experiments at the research facilities.
- Assistance with data analysis and result interpretation as agreed upon.

To be eligible to benefit from the Access to RI under the Science Link project, companies must satisfy the following conditions:

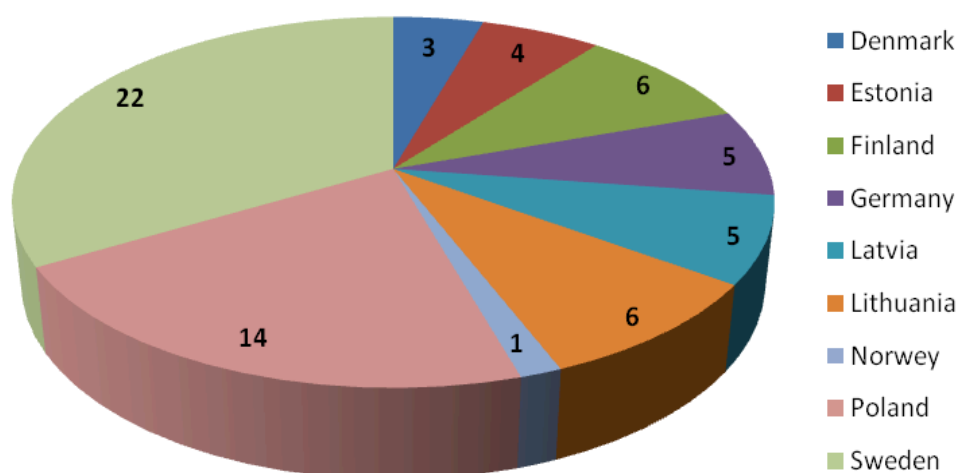
- the company must be affiliated in an EU Member State or in an Associated State of the Baltic Sea Region.
- the company is entitled to publicise the results of the EU Science Link supported experiments.

The proposals submitted and eligible for EU funding were refereed - together with all other proposals - by the Science Link Panel. The Panel assesses the scientific relevance of the R&D, the economical aspects and the importance of this study for the regional development.

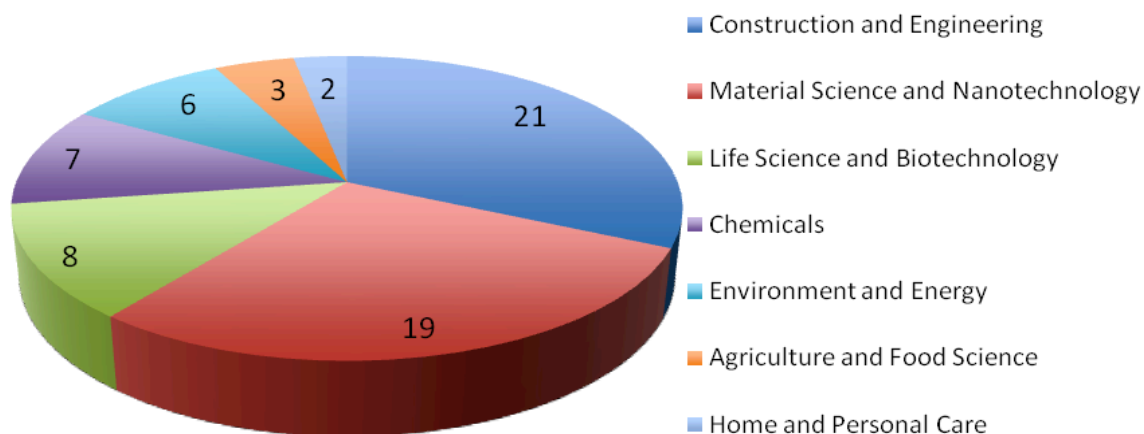
Results of three calls:

- 66 applications, companies from 8 countries have applied for access to brilliance
- A variety of industries represented
- 70% of the companies were SMEs
- Applications from 48 companies have been approved

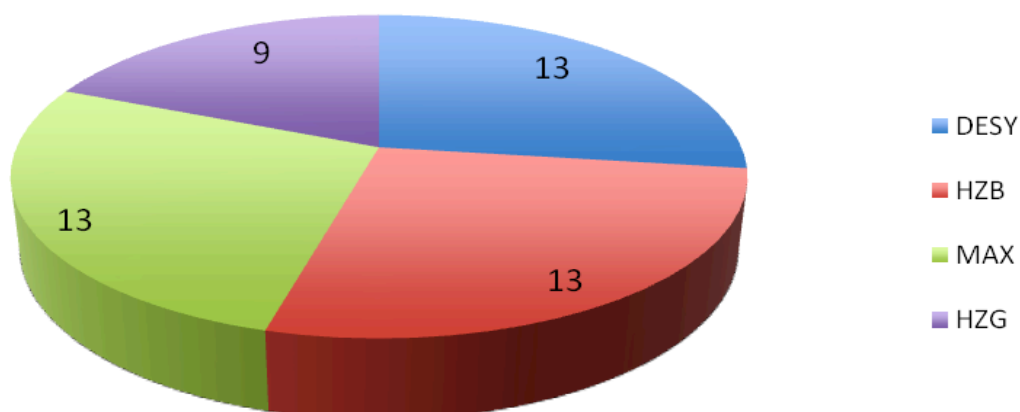
All application by countries



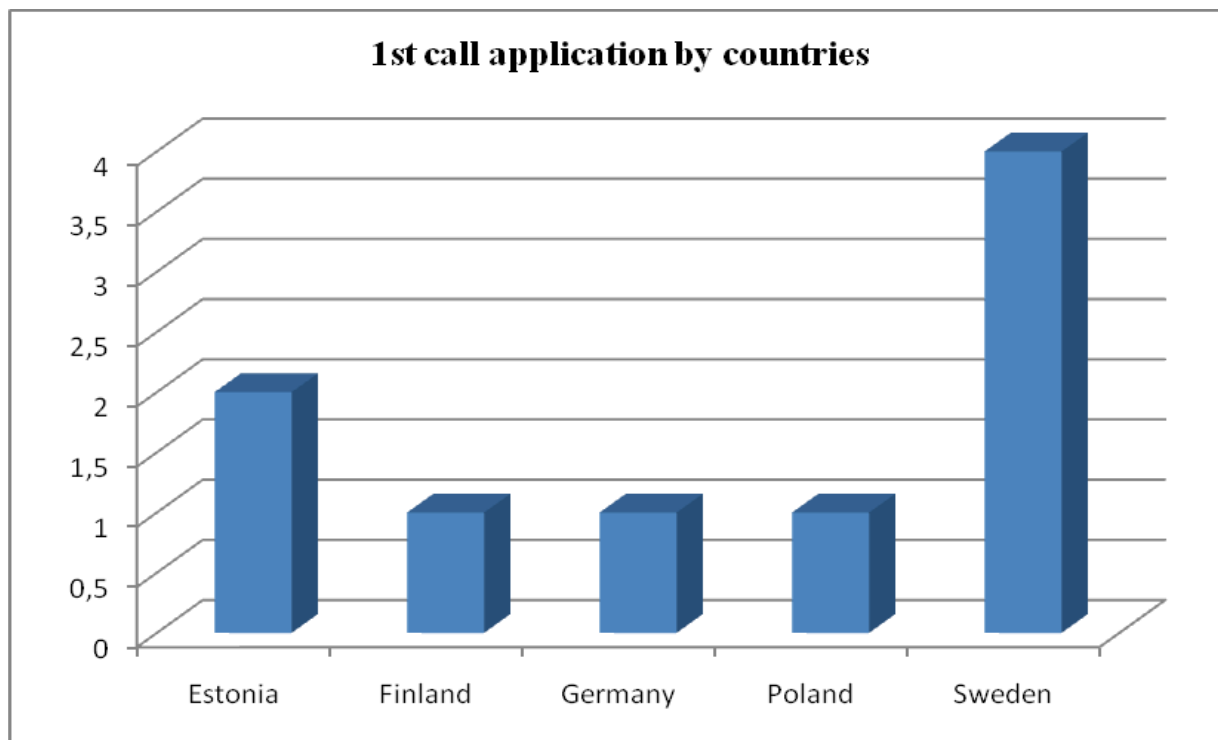
All application by industrial categories



Approved application by Research Infrastructures



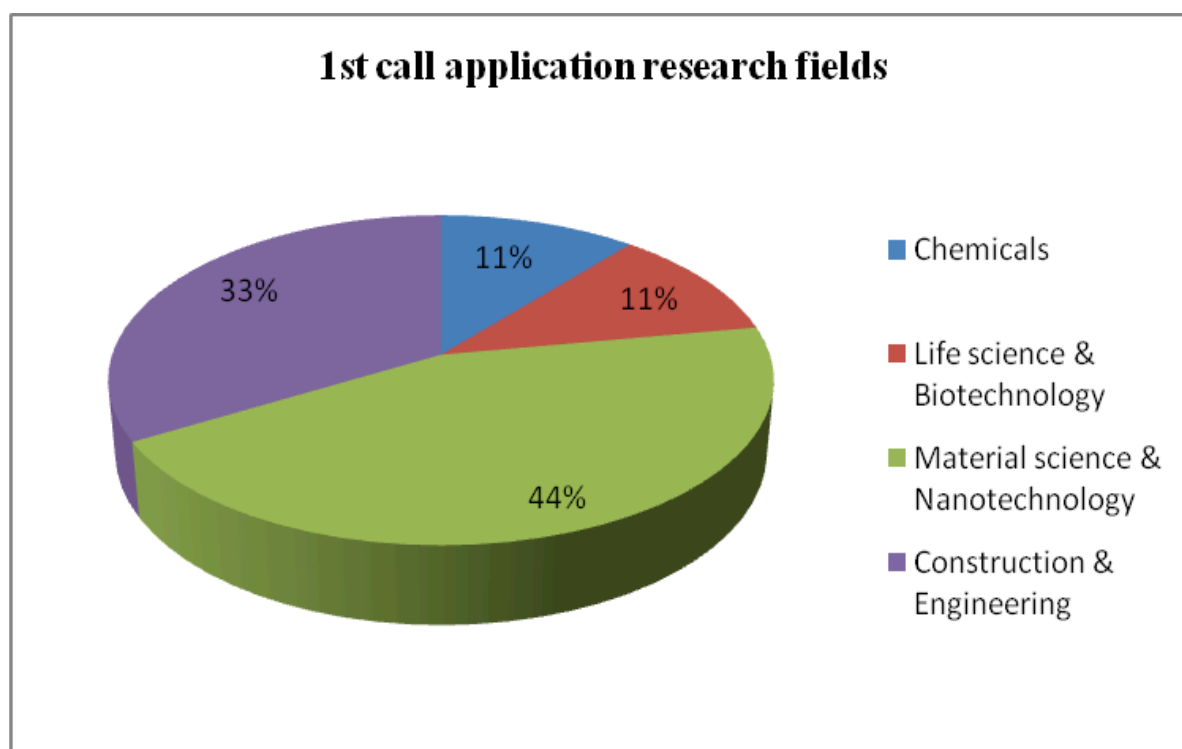
1.1 First call overview



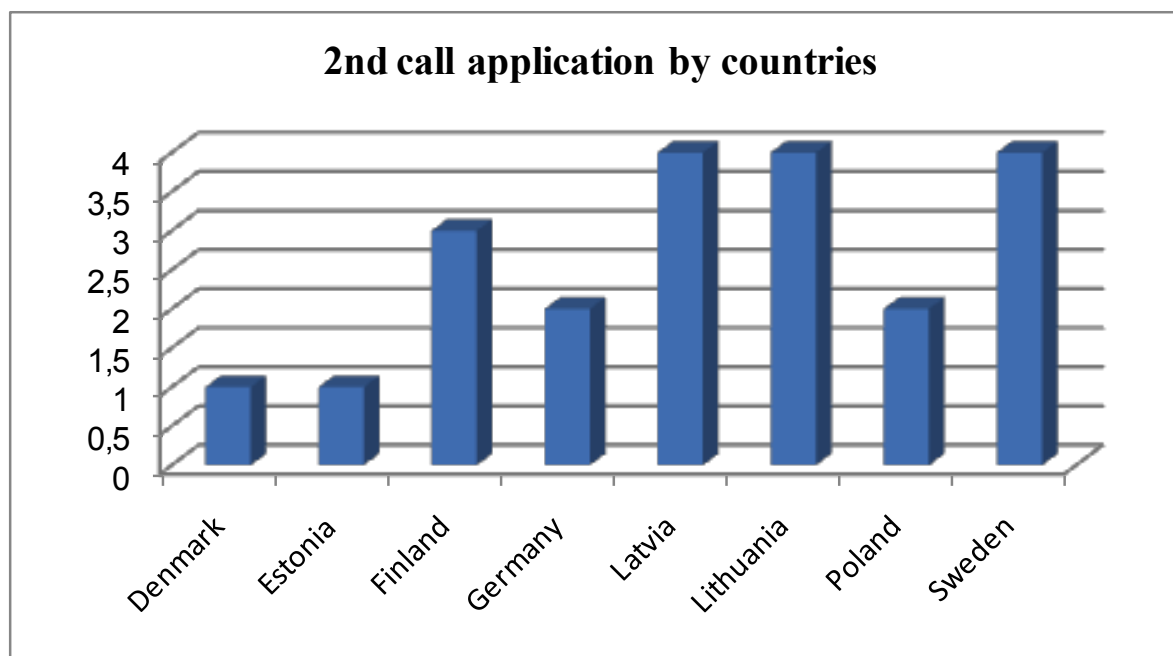
List of all applicants from 1st call of Science Link project

1st call (01.04.2012 – 30.04.2012)					
	COMPANY	COUNTRY	INDUSTRY	RI	ACCEPTED
1	VOLKSWAGEN AG	DE	CONSTRUCTION & ENGINEERING	HZG	YES
2	MEHI OY	FI	CONSTRUCTION & ENGINEERING	-	NO
3	HÖGANÄS AB	SE	MATERIAL SCIENCE & NANOTECHNOLOGY	MAX	YES

4	SPAGO IMAGING AB	SE	MATERIAL SCIENCE & NANOTECHNOLOGY	MAX	YES
5	VOLVO AB	SE	CONSTRUCTION & ENGINEERING	HZB	YES
6	CR COMPETENCE AB	SE	MATERIAL SCIENCE & NANOTECHNOLOGY	MAX	YES
7	MEXEO	PL	CHEMICALS	DESY	YES
8	SELFDIAGNOSTICS OÜ	EE	LIFE SCIENCE	-	NO
9	LUMIFOR OÜ	EE	MATERIAL SCIENCE & NANOTECHNOLOGY	DESY	YES



1.2 Second call overview



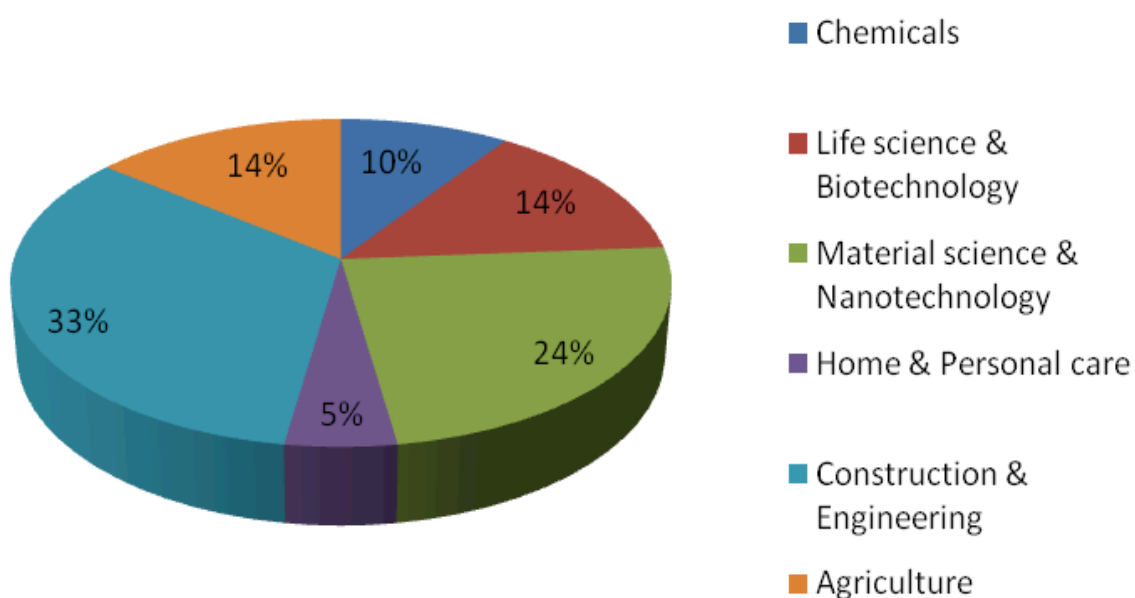
List of all applicants from 2nd call of Science Link project

2nd call (10.08.2012 – 20.09.2012)					
	COMPANY	COUNTRY	INDUSTRY	RI	ACCEPTED
1	ENTHONE NANOSCIENCE CENTER	Germany	MATERIAL SCIENCE & NANOTECHNOLOGY	DESY	YES
2	EVONIK INDUSTRIES AG	Germany	CONSTRUCTION & ENGINEERING	DESY	YES
3	DYRUP - PPG INDUSTRIES	Denmark	CONSTRUCTION & ENGINEERING	MAX	YES
4	CLIFTON AS	Estonia	MATERIAL SCIENCE & NANOTECHNOLOGY	MAX	YES

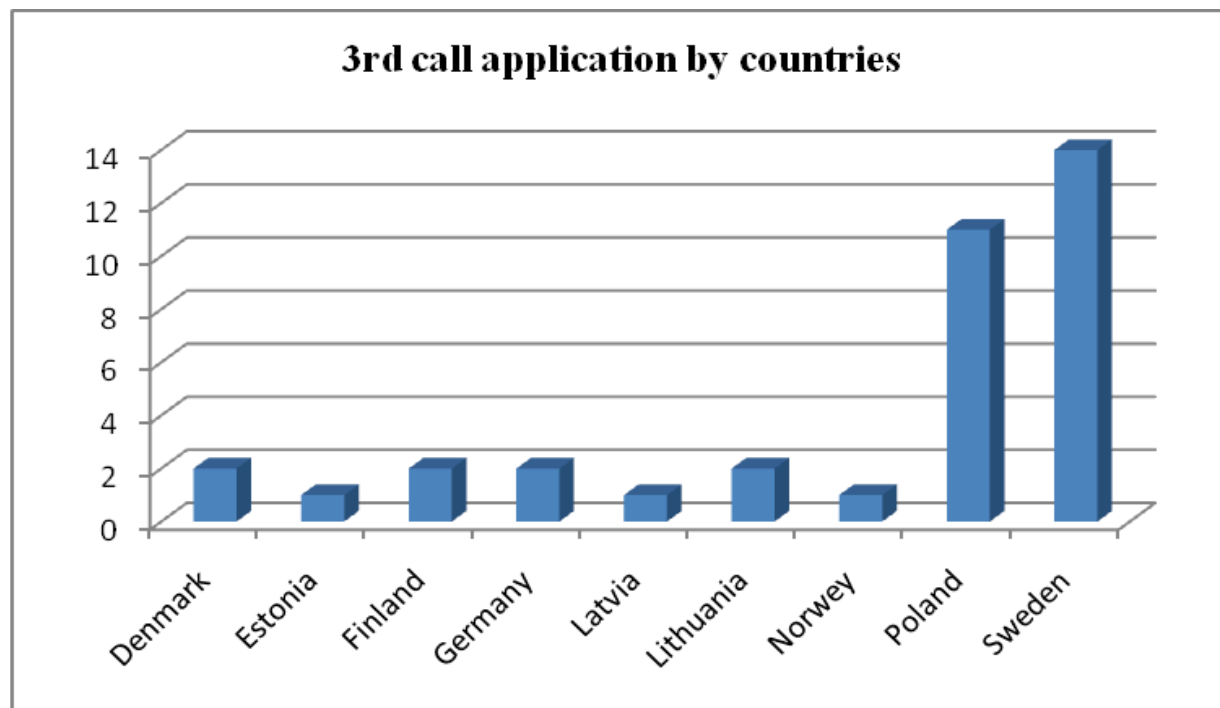
5	EKOPINE LTD - HANNU KOKKO	Finland	CONSTRUCTION & ENGINEERING	HZB	YES
6	NANO GEO FINLAND OY	Finland	AGRICULTURE	DESY	YES
7	YKKÖSMETALLI OY	Finland	CONSTRUCTION & ENGINEERING	HZG	YES
8	BALTUPIAI CENTER OF FAMILY MEDICINE	Lithuania	LIFE SCIENCE & BIOTECHNOLOGY	MAX	YES
9	LIDARIS LTD	Lithuania	MATERIAL SCIENCE & NANOTECHNOLOGY	MAX	YES
10	OPTIDA LTD	Lithuania	MATERIAL SCIENCE & NANOTECHNOLOGY	DESY	YES
11	SCIENTIFIC LASER & WAVE MED. CLINIC	Lithuania	LIFE SCIENCE & BIOTECHNOLOGY	---	NO
12	SIA DABBA	Latvia	LIFE SCIENCE & BIOTECHNOLOGY	---	NO
13	SIA DZINTARS	Latvia	PERSONAL CARE	DESY	YES
14	SIA SAPROVITAL	Latvia	AGRICULTURE	DESY	YES
15	SIA DENDROLIGHT LATVIJA	Latvia	CONSTRUCTION & ENGINEERING	---	NO
16	FAMAR S J	Poland	CHEMICALS	DESY	YES
17	ZCH ALWERNIA	Poland	AGRICULTURE	HZB	YES
18	COLLOIDAL RESOURCE AB (LKAB)	Sweden	CHEMICALS	HZG	YES
19	IMAGING RESOURCE AB	Sweden	CONSTRUCTION & ENGINEERING	HZG	YES

20	SECO TOOLS AB	Sweden	CONSTRUCTION & ENGINEERING	HZG	YES
21	SOLVOLTAICS AB	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY	MAX	YES

2nd call application research fields



1.3 Third call overview



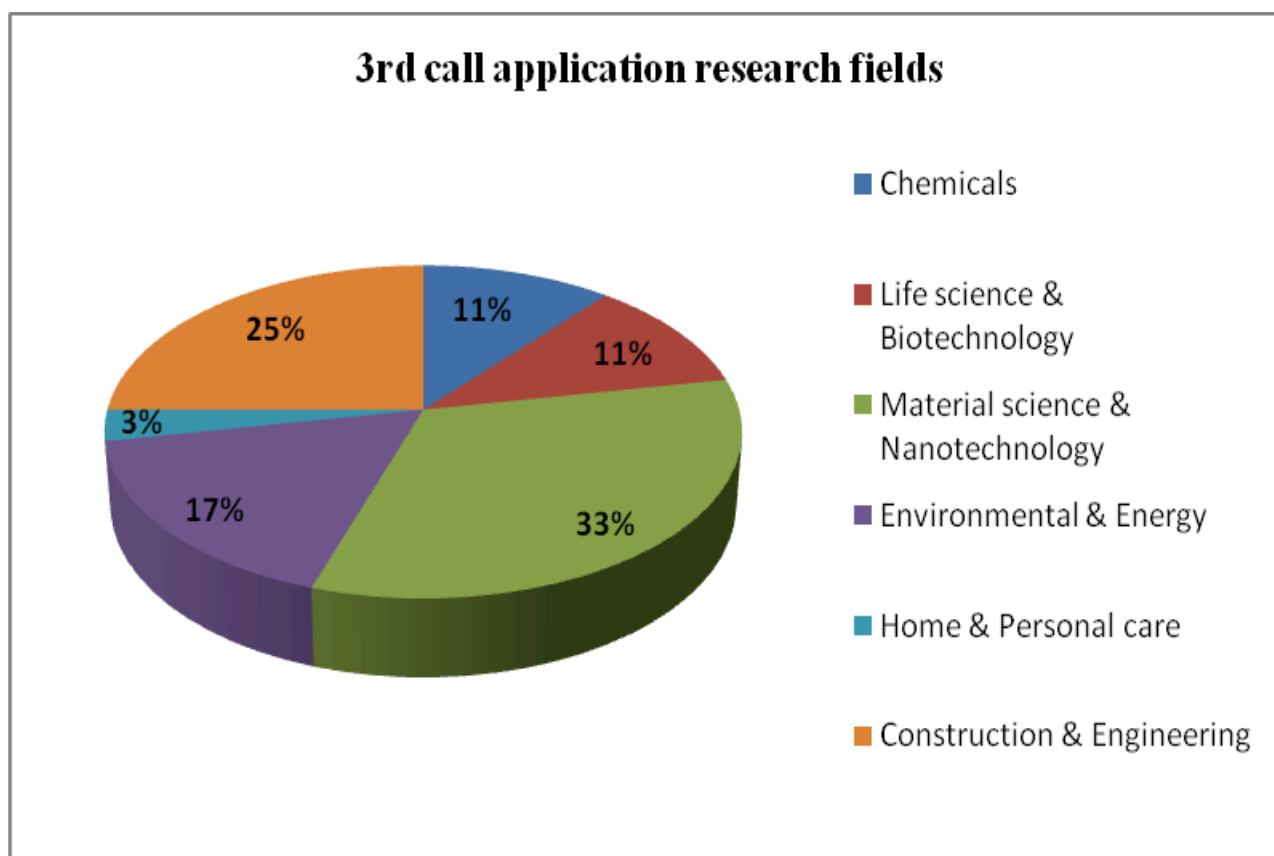
List of all applicants from 3rd call of Science Link project

3rd call (11.02.2013 – 22.04.2013)					
	COMPANY	COUNTRY	INDUSTRY	RI	ACCEPTED
1	MAHNKEN & PARTNER GBR	Germany	MATERIAL SCIENCE NANOTECHNOLOGY	HZB	YES
2	ODB-TEC GMBH & CO.KG	Germany	MATERIAL SCIENCE NANOTECHNOLOGY	HZB	YES
3	HBS ENGINEERING APS	Denmark	CONSTRUCTION & ENGINEERING	HZB	YES
4	JJ X-RAY A/S	Denmark	CONSTRUCTION & ENGINEERING	DESY	YES

5	AS NORMA	Estonia	MATERIAL SCIENCE & NANOTECHNOLOGY	HZB	YES
6	METSO OYJ	Finland	CONSTRUCTION & ENGINEERING		C
7	S.T. RITVANEN OY	Finland	ENVIRONMENT & ENERGY	MAX	YES
8	RA ASAI	Latvia	LIFE SCIENCE & BIOTECHNOLOGY	DESY	YES
9	LUTORA	Lithuania	ENVIRONMENT & ENERGY	MAX	YES
10	UNI - TOTS LTD	Lithuania	ENVIRONMENT & ENERGY		NO
11	CORTICALIS AS	Norway	LIFE SCIENCE & BIOTECHNOLOGY	HZG	YES
12	ANWIL S.A	Poland	MATERIAL SCIENCE NANOTECHNOLOGY		C
13	CERKAMED	Poland	CHEMICALS	HZB	Y C
14	CHEMLAB RESEARCH & DEVELOPMENT	Poland	CHEMICALS		C
15	CHEMICAL WORKS NITRO-CHEM SA	Poland	CHEMICALS		C
16	GRUPA KETY S.A.	Poland	CONSTRUCTION & ENGINEERING		C
17	LFC SP. Z O.O. LECHOSŁAW CIUPIK	Poland	LIFE SCIENCE & BIOTECHNOLOGY	HZB	YES
18	NOVMAX	Poland	CONSTRUCTION & ENGINEERING		NO
19	OFIR JACEK BILSKI	Poland	CHEMICALS	DESY	YES

20	TEKTO-KARTONAZ PPHU	Poland	CONSTRUCTION & ENGINEERING		NO
21	THERMOPLAST	Poland	CONSTRUCTION & ENGINEERING	MAX	YES
22	TRICOMED S.A.	Poland	LIFE SCIENCE & BIOTECHNOLOGY	DESY	YES
23	ALFA LAVAL	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY	HZG	YES
24	BIOPTECH	Sweden	ENVIRONMENT & ENERGY		C
25	CHROMALYTICA AB	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY	MAX	YES
26	CR COMPETENCE AB	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY		NO
27	GKN AEROSPACE	Sweden	CONSTRUCTION & ENGINEERING	HZB	YES
28	GRAPHENSIC AB	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY	MAX	YES
29	INGENJÖRSFIRMA LENNART OLSSON AB	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY	HZG or MAX	YES
30	ORBITAL SYSTEMS AB	Sweden	ENVIRONMENT & ENERGY	MAX + DESY	YES
31	PREBONA AB	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY		C
32	AB SANDVIK COROMANT R&D	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY	HZB	YES
33	SYDVATTEN AB	Sweden	ENVIRONMENT & ENERGY	MAX	YES
34	SPEXIMO AB	Sweden	HOME & PERSONAL CARE	MAX	YES

35	SWERIA IVF	Sweden	CONSTRUCTION & ENGINEERING	HZB	YES
36	VÄLINGE INNOVATION SWEDEN AB	Sweden	MATERIAL SCIENCE & NANOTECHNOLOGY		C



1.4 Maps of established cooperation

1.4.1 Map of companies located in Denmark



- 1 SØBORG:**
DYRUP - PPG INDUSTRIES
- 2 GLOSTRUP:**
HBS ENGINEERING APS
- 3 LYNGBY:**
JJ X-RAY A/S

1.4.2 Map of companies located in Estonia



1 TALINN:
- AS NORMA

2 TARTU:
- LUMIFOR OÜ
- CLIFTON AS

1.4.3 Map of companies located in Finland



- 1 OULU:**
 - EKOPINE LTD
 - HANNU KOKKO
- 2 VAASA:**
 - NANO GEO FINLAND OY
- 3 KAJAANI:**
 - YKKÖSMETALLI OY

- 4 HELSINKI:**
 - METSO OYJ
- 5 RAISIO:**
 - S.T. RITVANEN OY

1.4.4 Map of companies located in Germany



1 WOLFSBURG:
- VOLKSWAGEN AG (1st call)

4 AHAUSEN:
- MAHNKEN & PARTNER GBR

2 AMMERSBEK:
- ENTHONE NANOSCIENCE CENTER

5 NEUSS:
- ODB-TEC GMBH & CO.KG

3 ESSEN:
- EVONIK INDUSTRIES AG

1.4.5 Map of companies located in Latvia



- 1 RAUNA:**
 - SIA DABBA
- 2 RIGA:**
 - SIA DZINTARS
 - SIA SAPROVITAL

1.4.6 Map of companies located in Lithuania



- 1 VILNIUS:**
 - BALTUPIAI CENTER OF FAMILY MEDICINE
 - L IDARIS LTD
 - OPTIDA LTD
- 2 SIAULIAI:**
 - LUTORA

1.4.7 Map of companies located in Poland



- | | |
|---|---|
| 1 KĘDZIERZYN KOŹLE :
- MEXEO | 7 BYDGOSZCZ:
- CHEMICAL WORKS NITRO-CHEM SA |
| 2 DANKOWICE:
- FAMAR S J | 8 KĘTY:
- GRUPA KETY S.A. |
| 3 ALWERNIA:
- ZCH ALWERNIA | 9 ZIELONA GÓRA:
- LFC SP. Z O.O. |
| 4 WŁOCŁAWEK:
- ANWIL S.A | 10 OSTRZESZÓW:
- OFIR |
| 5 STAŁOWA WOLA:
- CERKAMED | 11 LIBIAŹ:
- THERMOPLAST |
| 6 KIELCE:
- CHEMLAB RESEARCH & DEVELOPMENT CENTER | 12 ŁÓDŹ:
- TRICOMED S.A. |

1.4.8 Map of companies located in Sweden



- 1 HÖGANÄS:**
- HÖGANÄS AB
- 2 GÖTEBORG:**
- VOLVO AB
- 3 LUND:**
- CR COMPETENCE
- COLLOIDAL RESOURCE
- IMAGING RESOURCE
- SOLVOLTACS
- ALFA LAVAL
- GKN AEROSPACE
- INGENJÖRSFIRMA LENNARD OLSSON
- ORBITAL SYSTEMS
- PREBONA
- SPEXIMO
- 4 STOCKHOLM:**
- SPAGO IMAGING
- BIOPTECH
- SANDVIK COROMANT
- 5 FAGERSTA:**
- SECO TOOLS
- 6 MALMÖ:**
- CHROMALYTICA
- SYDVATTEN
- 7 LINKÖPING:**
- GRAPHENSIC
- 8 MÖLNDAL:**
- SWERIA IVF
- 9 VIKEN:**
- VÄLINGE INNOVATION

3. EXPERIMENTS OVERVIEW

2.1 Examples of the Case Studies – Material Science

	NAME	ADRESS	CALL	INDUSTRIAL CATEGORIES	RI
1.	LUMIFOR OÜ	TARTU, ESTONIA	1st	MATERIAL SCIENCE	HZB
2.	CLIFTON AS	TARTU, ESTONIA	2nd	MATERIAL SCIENCE	MAX

COMPANY PROFILE

Name:

LUMIFOR OÜ

Address:

Tartu, Estonia

Scopes and fields of activity

Professional, scientific and technical activities

EXPERIMENT OVERVIEW

OPTIMIZED MATERIALS FOR EFFICIENT RADIATION PROTECTION

A significant contribution to scientific progress in the last century has arisen from the discovery of radiation, which is produced by nuclear reactors, particle accelerators, radioactive materials and conventional x-ray sources. Scientists, engineers and technicians who work in these fields require radiation dosimeters to monitor any undesired exposure to radiation. Investigating the use of new materials in these dosimeters is required in order to find more sensitive and efficient materials.

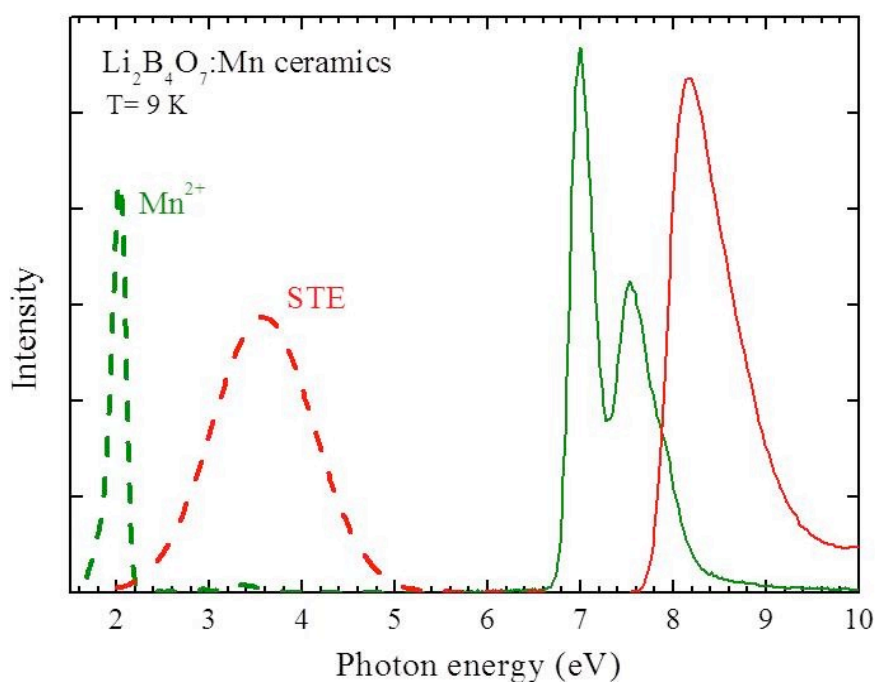
LUMINESCENT DOSIMETERS

The Estonian dosimeter company Lumifor OÜ is developing new dosimeters containing the luminescent material $\text{Li}_2\text{B}_4\text{O}_7:\text{Mn}$, but further measurements were needed to fully understand the electronic processes that take place during the radiation detection.

The function of the dosimeter is based on the process of Thermoluminescence (TL), during which a previously irradiated material is heated to a high temperature and the emitted visible light is proportional in intensity to the absorbed radiation dose. The electronic mechanisms responsible for this phenomenon can be rather complicated and to optimize the material's performance as a dosimeter, spectral analysis on the emission and excitation properties of their visible luminescence is necessary.

MEASURING EXCITATION AND EMISSION SPECTRA

A study within the Science Link project enabled the investigation of samples of $\text{Li}_2\text{B}_4\text{O}_7:\text{Mn}$ using synchrotron vacuum ultraviolet (VUV) radiation at DESY in Hamburg, and typical excitation and emission spectra are shown in Figure 1. Two very different emission peaks were observed which have been attributed to dopant Mn ions and to self-trapped excitons (STEs) which arise from the $\text{Li}_2\text{B}_4\text{O}_7$ matrix itself, as indicated in Figure 1. The origin of each luminescence peak is proven by analysis of the excitation spectra. Excitation spectra at such high energies are not possible with standard laboratory spectrometers. The emission spectra could be compared to that observed during the TL process, and all TL peaks could be shown to arise from luminescent Mn dopant ions. This understanding of the electronic processes involved in the luminescence mechanism in $\text{Li}_2\text{B}_4\text{O}_7:\text{Mn}$ dosimeter materials, has enabled Lumifor to continue developing and optimizing their products.



VUV excitation (solid lines) and emission spectra (dashed lines) of $\text{Li}_2\text{B}_4\text{O}_7:\text{Mn}$ ceramic materials measured at 9K at DESY

COMPANY PROFILE

Name:

CLIFTON AS

Address:

Tartu, Estonia

Scopes and fields of activity

Producer of gallium arsenide semiconductors for power electronics.

EXPERIMENT OVERVIEW

SENSITIVE PROCESSES BEHIND USING GaAs IN POWER ELECTRONICS

Most electrical devices have to control and convert electrical energy, but a significant amount of energy is lost during these power electronics processes, reducing both power efficiency and reliability of electrical and mechanical systems such as hybrid and electric vehicles, solar inverters, wind turbines and home electronics. Experiments at the MAX IV Laboratory have provided methods for measuring the GaAs oxidation, which have helped the Estonian company Clifton AS to further develop their efficient Liquid Phase Epitaxy (LPE) technology.

There are currently three alternative semiconductor materials in use in power electronics – Silicon (Si), Silicon Carbide (SiC) and Gallium Nitride (GaN). Silicon does not perform well in higher energy density and temperature conditions, and SiC and GaN cannot be used for higher currents and are often too expensive.

GaAs has been widely used in microelectronics due to its suitability for high frequency and temperature, but not for controlling and converting electrical energy – not in power electronics as it has been complicated to find the technology to achieve higher reverse voltages.

LOWER ENERGY CONSUMPTION

The Estonian power electronics development company Clifton AS has developed Liquid Phase Epitaxy (LPE) technology, to produce efficient, fast, high voltage and low capacitance Gallium Arsenide (GaAs) structures and chips for power electronics. It opens the possibility for less energy consumption, smaller and lighter products.

The GaAs LPE production process is extremely sensitive and the properties of the material can rapidly change due to oxidation. Experiments at the MAX IV Laboratory enabled scientists to measure the GaAs oxidation in a way that has not been possible with other methods of measurement.

Clifton collaborates closely with the Institute of Physics at the University of Tartu and professor Ergo Nommiste, whose work includes participation in the development and

evaluation of Clifton's proprietary LPE process. He was also entrusted with measuring potential oxidation during Clifton's production process.

"Clifton has to produce complex gallium arsenide structures", says Ergo Nommiste. "We knew that these can be easily affected by the air around them and that oxidation could cause the substance's properties to deteriorate, but the oxidation process was not measurable with our own equipment. The opportunity for beamtime at the MAX IV Laboratory via Science Link, was therefore very timely and it enabled us to conduct measurements at a completely new level."

OBSERVING THE OXIDATION PROCESS

On site at the MAX IV Laboratory, a series of experiments were carried out with different GaAs samples prepared by Clifton. These samples were differently exposed to ambient air. Unlike the experiments that were conducted in the home lab, these sensitive experiments showed oxidation process dynamics immediately after the sample was exposed.

"We could see exactly how oxidation progressed and how deep into the material it went", says Ergo Nommiste. "This means that Clifton has got proof of the dynamics of oxidation processes for different stages. The new knowledge enabled Clifton to further refine its processes."

Clifton's CEO Jaak Anton is very satisfied with the results. *"Our close cooperation with the scientists of the Institute of Physics and the experiments at MAX IV Laboratory under Science Link enabled a deeper understanding of the processes and provided additional knowledge about the oxidation rates and compositions for different intermediate products. It gave us additional information to optimize our processes according to the results received by these measurements and we hope to make few additional measurements to verify decisions made", says Jaak Anton.*

2.2 Examples of the Case Studies – Agriculture

	NAME	ADRESS	CALL	INDUSTRIAL CATEGORIES	RI
1.	NANOGEO FINLAND OY	VAASA, FINLAND	2nd	AGRICULTURE	DESY

COMPANY PROFILE

Name:

NANOGEO FINLAND OY

Address:

Vaasa, Finland

Scopes and fields of activity

Develop and sell environmental related technology, services and products.

EXPERIMENT OVERVIEW

CONVERTING RUSSIAN CLAYS INTO NITROGEN FILTER AND NATURAL FERTILISER

Modern agriculture depends on the use of environmentally friendly fertiliser materials to ensure that healthy food can be produced with a high efficiency.

The small start-up company NanoGeo Finland Oy produces a natural fertiliser based on the common geological mineral vermiculite. The production of fertiliser is based on the utilization of nanoscale structures and properties of the mineral – when vermiculite is heated, its capability to absorb ammonium is increased. The absorption of ammonium results in the formation of ammoniumvermiculite, which is a fertiliser for plants. One source of ammonium for the fertiliser is ammonium-containing wastewater produced by human activity. This recovery of ammonium is a very useful technique that benefits agriculture as well as the environment.

MEASURING CRYSTALLINE PHASES

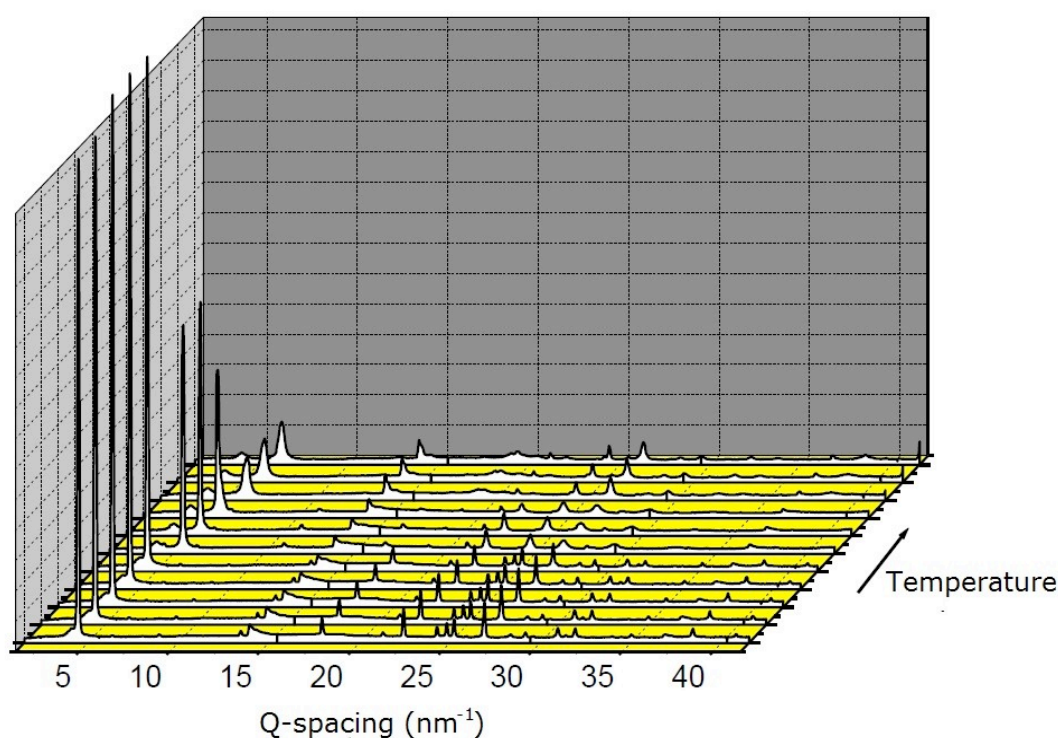
To understand the structural changes that take place during the initial heating of vermiculite, a study within the Science Link project allowed the analysis of several samples of NanoGeo's vermiculite, using intense x-ray radiation produced at the PETRA III synchrotron at DESY in Hamburg. X-ray diffraction (XRD) is used to measure crystalline

phases present within a sample, and the beamline P02 is dedicated to high resolution powder diffraction at different pressures and temperatures. The ability to create extreme conditions is complemented by time resolved diffraction capabilities in order to explore the kinetics of physical processes during a phase transition – a technique that is only possible at a synchrotron facility like DESY.

Powdered samples of the mineral were placed into glass capillaries and heated from 25 – 580°C. An XRD measurement was made every 2 – 3°C to observe the heat induced structural changes. The results are shown in Figure 1. It was found that during the heating, crude vermiculite passes through five discrete structural transformations, involving three steps of reversible dehydration and two irreversible dehydroxylation steps resulting in decomposition of the vermiculite to talc and, finally a form of $Mg_2Si_2O_6$.

REDUCING ENERGY CONSUMPTION

Results such as those shown in Figure 1, showed the temperatures of the structural changes of vermiculite required to create the best possible ammonium filter. This understanding has allowed NanoGeo to reduce the energy consumption of the manufacturing process of their filtering sands. Further measurements were performed on heated vermiculite before and after it was exposed to ammonia, and chemical reactions governing ammonia absorption by vermiculite were identified.



XRD data showing structural changes in Russian vermiculite during heating from 25°C – 580°C

2.3 Examples of the Case Studies – Engineering

	NAME	ADRESS	CALL	INDUSTRIAL CATEGORIES	RI
1.	VOLKSWAGEN AG	WOLFSBURG, GERMANY	1st	ENGINEERING	HZG

COMPANY PROFILE

Name:

VOLKSWAGEN AG

Address:

Wolfsburg, Germany

Scopes and fields of activity

Automotive.

EXPERIMENT OVERVIEW

INVESTIGATION OF RESIDUAL STRESSES ON NEW LIGHTWEIGHT COMPONENTS

Volkswagen AG is one of the largest auto- motive companies in the world. Science Link and Volkswagen engineers investi- gated residual stresses in test castings of recently developed aluminium based alloys for high strength lightweight com- ponents.

CONFIRMATION OF SIMULATED VALUES

Measurements on two different types of components, a cylinder head prototype and a stress lattice, were performed by HZG at PETRA III (DESY). The results confirmed the residual stress simulations to a good degree.

INCREASING RELIABILITY IN DURABILITY PREDICTIONS

Some aluminium alloys require a heat-treatment step that forms precipitates in the work piece, important for the hardness of the material. Following heat- treatment, a high level of residual stress is produced which can superimpose with load stresses during operation and therefore decrease the lifetime of the component. Simulations have been made by Volkswagen engineers to predict these stresses and increase the reliability in durability predictions.

High-energy X-ray diffraction is a suitable, non- destructive method to validate these

simulations. By applying the conical slit cell technique, a depth resolution of about 2 mm was obtained.

SOLVING MATERIALS PROBLEMS

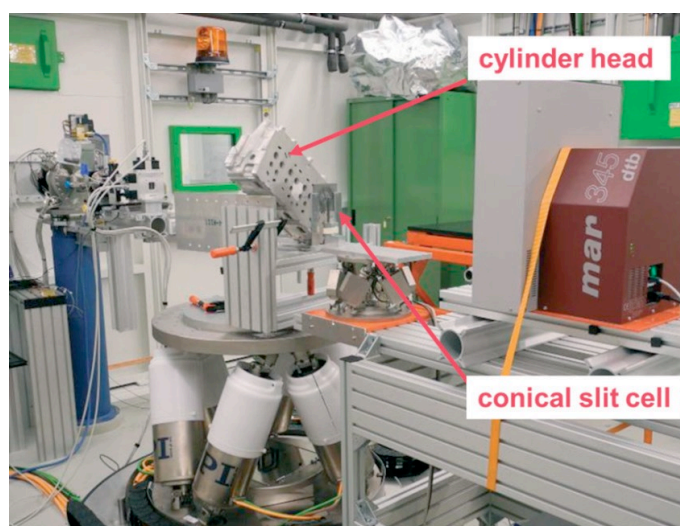
Science Link provides a unique infrastructure for complementary research with photons and neutrons. The support we provide companies include consultations prior to an application, consultations during and after an experiment (analysis of the results).

Industry specific user support

- BUFSJBMT 4DJFODF TVQQPSU MBCT (TBNQMFQSFQBSBUJPO and characterisation)
- %BUB BOBMZTJT *O TJUV TBNQMF FOWJSPONFOUT:
- 'VSOBDFT
- \$PPMJOH EFWJDFT
- 4USFTT SJHT
- %JMBUPNFUFS
- -BTFS BOE GSJDUJPO TUJS XFMEJOH EFWJDFT

State of the art materials analysis well Beyond the capabilities of standard laboratory equipment:

- 3-% JNBHJOH (SBEJPHSBQIZ, UPNPHSBQIZ)
- 3FTJEVBM TUSFTT NFBTVSFNFOUT
- "OBMZTJT PG QIBTF USBOTGPSNBUJPOT
- \$IBSBDUFSJTBUJPO PG OBOPTUSVDUVSFE IBSE BOE TPGU matter Samales



Residual stress distributions in sample volume

2.4 Examples of the Case Studies – Construction

	NAME	ADRESS	CALL	INDUSTRIAL CATEGORIES	RI
1.	EVONIK INDUSTRIES AG	ESSEN, GERMANY	2nd	CONSTRUCTION	DESY

COMPANY PROFILE

Name:

EVONIK INDUSTRIES AG

Address:

Essen, Germany

Scopes and fields of activity:

Specialty chemicals companie.

EXPERIMENT OVERVIEW

UNDERSTANDING DISPERSANTS IN PAINTS, PIGMENTS AND DYES

Dispersant agents are crucial to many diverse fields of application such as in paints, plastics, cosmetics and construction.

In general, dispersant agents improve the homogeneity of a system of particles by being absorbed on to particle surfaces and they assist in compatibilization of the surrounding medium and mediation of particle interactions. This helps improve colour strength and stability in paints and cosmetics, hardening and strength in construction as well as mechanical properties in plastics.

MEASURING DISPERSED PARTICLES

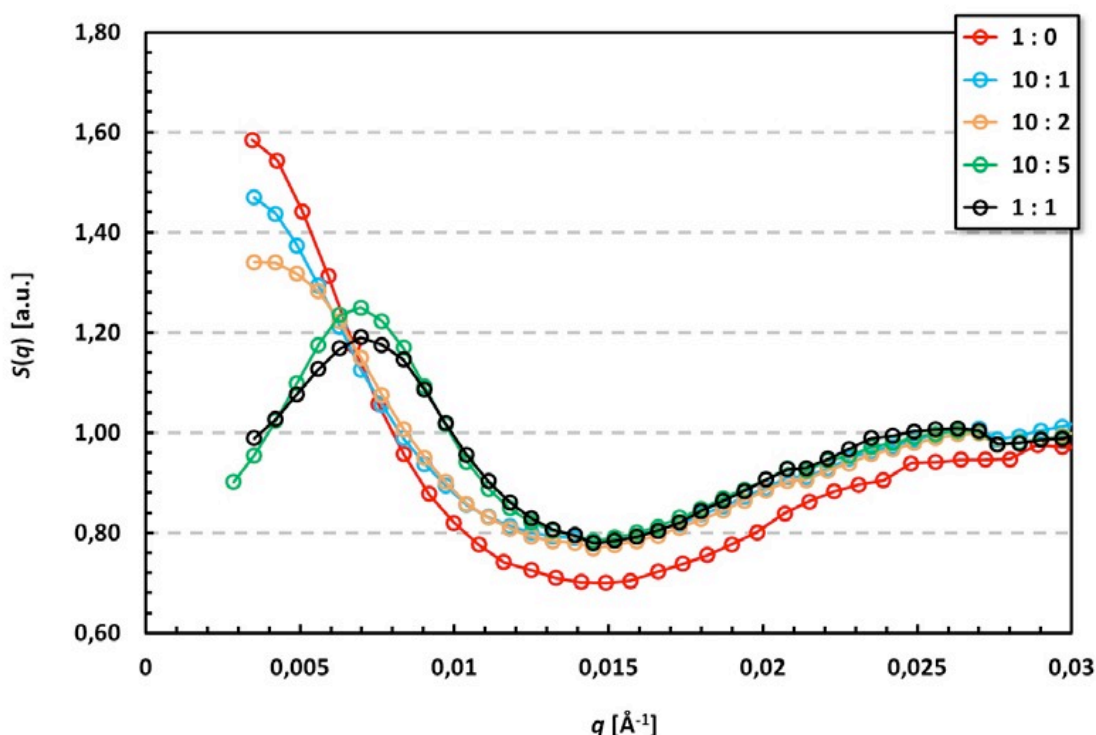
Evonik Industries produces many different systems that require the use of dispersants, but until now the actual mode of action is only poorly understood.

To help understand these systems, a series of measurements made possible via the Science Link project, were performed using Small Angle X-ray Scattering (SAXS) at the Coherence Beamline P10 at PETRA III at DESY in Hamburg. SAXS is sensitive to the size, structure, distribution, orientation and aggregation of particles in a solution and is a very useful technique for investigating Evonik's materials. Figure 1 shows typical results from the measurements, from which valuable information could be obtained on how dispersant

molecules influence the interactions between dispersed particles.

LOW VS. HIGH CONCENTRATION

It was found that in low concentration, the dispersant only insufficiently covers the surface of the scattering particles and hence cannot completely screen attractive interactions between the particles. For high dispersant concentrations however, i.e. when a sufficient surface coverage of the particles by dispersant molecules is achieved, repulsive interactions between the scattering particles are induced – i.e. the system is sterically stabilized. This is shown schematically in Figure 2. It is hoped that this improved understanding of the mode of action of the dispersant molecules will lead to an optimization of Evonik's products.



Interparticle structure factor $S(q)$ of the system SiO₂ – Dispersant in solution for different SiO₂ to dispersant ratios. $S(q)$ was extracted from the experimental scattering data recorded at DESY

2.5 Examples of the Case Studies – Chemicals

	NAME	ADRESS	CALL	INDUSTRIAL CATEGORIES	RI
1.	FAMAR S J	DANKOWICE, POLAND	2nd	CHEMICALS	DESY

COMPANY PROFILE

Name:

FAMAR S J

Address:

Dankowice, Poland

Scopes and fields of activity:

Chemicals

EXPERIMENT OVERVIEW

NEW CATALYSTS FOR CLEAN, GREEN CHEMISTRY

Important challenges of the 21st century include the reduction of CO₂ emission to combat climate change, as well as the development of new materials for hydrogen storage for future energy technologies.

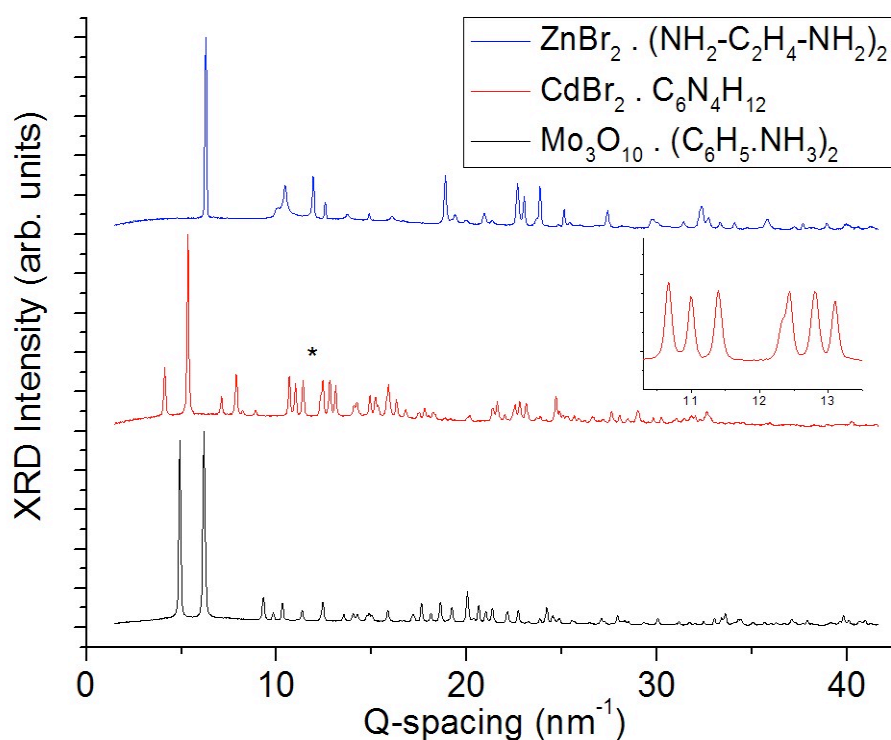
The Polish chemical company FAMAR in Dankowice produces chemical catalysts for industrial processes that limit the emission of harmful gases and also are useful for storage of gases such as CO₂ and H₂. Many of the produced catalysts are of unknown structures and they consist of complex mixtures of metals or metal clusters connected by rigid organic groups, for example Mo₁₀O₁₀.(C₆H₅NH₃)₂ and ZnBr₂.(NH₂-C₂H₄-NH₂)₂.

NEW WAYS TO MEASURE CRYSTAL STRUCTURES

To understand the crystal structure of these novel materials, a study within the Science Link project enabled the performance of high resolution X-ray Diffraction (XRD) at the P02 beamline at DESY in Hamburg. XRD is a technique used to measure the crystal structure of ordered materials – and information about the space groups, lattice constants and atomic positions can be extracted.

The unique nature of the synchrotron radiation produced by the PETRA III storage ring, as

well as the special features of the diffractometer setup at P02, enabled for high-resolution XRD patterns to be obtained. These measurements have been instrumental in solving the crystal structure of many complex materials, and many features of the measured diffraction patterns were superior to those measured using conventional laboratory diffractometers. The peaks that are very close together and that usually would overlap were made distinguishable with the synchrotron source (indicated with an asterisk in Figure 1), as well as the crystal phases present in the mixture of amorphous phases that are undetectable with conventional sources. These measurements have enabled FAMAR to determine the crystal structures of many new catalyst materials for modern, clean technologies.



High resolution X-ray diffraction patterns for several compounds produced by FAMAR, measured at DESY. The inset highlights the high resolution obtained for the peaks marked with (*) which would not be distinguishable without a synchrotron radiation source.

2.6 Examples of the Case Studies – Nanotechnology

	NAME	ADRESS	CALL	INDUSTRIAL CATEGORIES	RI
1.	CR COMPETENCE	LUND, SWEDEN	1st	NANOTECHNOLOGY	MAX
2.	GRAPHENSIC	LINKÖPING, SWEDEN	3rd	NANOTECHNOLOGY	MAX

COMPANY PROFILE

Name:

CR COMPETENCE AB

Address:

Lund, Sweden

Scopes and fields of activity:

CRO company with expertise in colloidal and surface chemistry.

EXPERIMENT OVERVIEW

NANO-STRUCTURES IN A LIFE VEST

A wearable “kidney” in the form of a comfortable vest, could improve quality of life for several million people suffering from kidney disease, and who currently need stationary dialysis. Blood purification requires an advanced chemical filter with a structure that must be precise right down to the atomic level. Experiments at the MAX IV Laboratory have provided important knowledge for a quality-assured production process.

CR Competence (CR) are experts in giving surfaces and interfaces special properties, by tailoring them at the nano level. Their clients are companies that need advanced knowledge of chemistry and qualified investigative methods for improved product development. One client is the medical technology company Triomed, which is developing a light, wearable dialysis vest, to provide kidney disease patients with increased freedom of movement. Dialysis takes place continuously, which means that the level of waste products in the blood is maintained at a constant low, enabling the wearer of the vest to feel better.

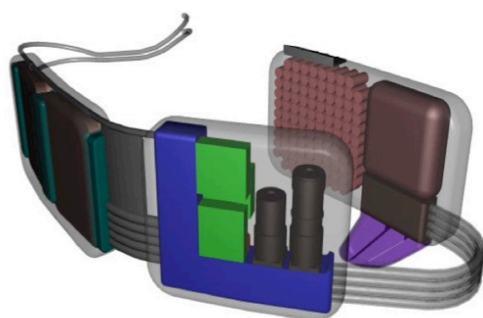
OPTIMIZING THE PRODUCTION PROCESS

Among other tasks, CR was commissioned to optimize the production process of one of the chemical filters that purify the dialysis liquid. The filter consists of a porous material with metal ions bound to a polymer matrix according to a very precise structure. Structure and function are closely linked – studying the effect of various process parameters on the structure provides a unique opportunity to follow the effect of the process on the crucial function.

“We needed proof that the production process was working as it should” says CR’s CEO Anna Stenstam. “As we know exactly how the material needs to be in order to function optimally, we wanted to find a way to study it in the most minute detail – right down to the level at which we could see how the individual metal ions were bound to the polymer matrix.”

A POWERFUL METHOD

In order to obtain a sufficiently detailed image of the filter material, there was only one viable method – EXAFS – available at the MAX IV Laboratory, in Lund. “We applied for experiment time at the MAX IV Laboratory on behalf of Triomed via Science Link. The measurements with the EXAFS method gave us a very clear picture of the structure. The result is that we have been able to pinpoint exactly how we need to adjust the production process in order to obtain a perfectly functioning material. We have been able to provide both ourselves and our client with new knowledge and we have contributed to a better final product, all while saving time and money”, says Anna Stenstam, who believes that Triomed may well conduct more experiments with EXAFS.



Triomed's wearable "kidney" could improve quality of life for several million people suffering from kidney disease

COMPANY PROFILE

Name:

GRAPHENSIC

Address:

Linköping, Sweden

Scopes and fields of activity:

Produces and supplies epitaxial graphene on silicon carbide.

EXPERIMENT OVERVIEW

NOBEL PRIZE MATERIAL REQUIRES EXTREME PRECISION

Full control of both the product and the production process are requirements when you produce something that has to be exactly one atom thick. Graphensic AB in Linköping turned to the MAX IV Laboratory – and got unexpected useful information into the bargain.

Graphene is a material consisting of only one layer of carbon atoms arranged in a hexagonal pattern, which gives the material a number of unique properties. It is 200 times stronger than steel, it conducts electricity better than any other material and it can detect single molecules on its surface. After the discovery of graphene led to a Nobel Prize in 2010, the EU invested one billion Euros in a graphene flagship project that is to accelerate its development towards industrial application. Applications of graphene on silicon carbide include biosensors and superfast transistors.

Graphensic has developed a patented method of producing graphene on silicon carbide.

“When silicon carbide is heated up, it moves into the gaseous phase resulting in a residual layer of carbon atoms when the silicon leaves the surface”, explains Mikael Syväjärvi, co-founder of Graphensic. “Our customers today are mainly within the research world, but industry is showing an interest and I expect it will take between five and ten years before graphene is used in common electronic products. In Sweden there is a graphene agenda working to ensure that Swedish industry is in a position to benefit from the opportunities offered by graphene.”

DOUBLING PRODUCTION

The increased demand for the new super material puts pressure on production. Graphensic is currently producing 50 millimetre wafers, but will shortly be able to start production of wafers with double that diameter.

“The production of an atom-thick layer requires an extreme precision and must also, of course, be repeatable in our processes. Our measurements at the MAX IV Laboratory aimed to characterize our material on the basis of various production parameters by studying it in a

completely controlled environment, using a powerful instrument to which we do not have access ourselves”, says Mikael Syväjärvi.

A NEW PROCESS TO RECOMMEND

In addition to obtaining a better picture of the even- ness and quality of the material in its production process, among other things, Mikael Syväjärvi got information from the experiments that could be fed back into Graphensic’s procedures.

“It emerged that in storage, the material could ac- quire molecules from the surrounding air. It is not a process of oxidation which happens with many common materials, but rather that the molecules can rest in patches on the surface. These can be removed simply by warming up the material and we can now recommend this process to our clients if they store the products for a long time.”



The high temperature graphene process uses induction heating to fabricate the material as precise as possible

2.7 Examples of the Case Studies – Environment & Energy

	NAME	ADRESS	CALL	INDUSTRIAL CATEGORIES	RI
1.	SYDVATTEN	MALMO, SWEDEN	3rd	ENVIRONMENT & ENERGY	MAX

COMPANY PROFILE

Name:

SYDVATTEN

Address:

Malmö, Sweden

Scopes and fields of activity:

Producers of drinking water.

EXPERIMENT OVERVIEW

TAKING MICROSCOPY TO A WHOLE NEW LEVEL

Waterworks sludge contains organic substances bound to the iron used in the purification process. By studying the structure of the sludge at the atom- ic level, it can be possible to recycle the iron while making the sludge residue more usable for soil improvement, for example.

Sydvatten delivers drinking water to 900 000 people in southern Sweden. The water is taken mainly from the Bolmen lake and runs through a tunnel, 80 kilometers long, to the Ringsjöverket waterworks, where the raw water is converted into drinking water. Ferric chloride is used in the purification process to cause a chemical precipitation that removes microorganisms, solid particles and unwanted substances from the raw water. In the residual sludge, organic substances are bound to iron compounds. The sludge is harmless and could for example be used to bind phosphorus in agricultural land. But currently there are no competitive methods to recycle to ferric chloride, something that could entail financial gain and be good for the environment.

“Large volumes are involved”, says Kenneth M Persson, head of research at Sydvatten and Professor of Water Resources Engineering at Lund University’s Faculty of Engineering, LTH.

“Sydvatten’s waterworks produce approximately 70 million cubic meters of drinking water per year and that gives rise to several thousand tons of ferric chloride. We would like to retrieve and reuse the ferric chloride, but the bond between the organic substances in the sludge and the iron compounds that take form are very complex and difficult to study. We

therefore turned to the MAX IV Laboratory, through the Science Link project, in the hope of obtaining a clearer picture of the structure of the sludge.”

FIRST EVER IN 3D

With the help of the staff at the MAX IV Laboratory, EXAFS was identified as a suitable technique to analyze Sydsvatten’s sludge samples. The conducted experiments provided the first ever three-dimensional image of the structure of the sludge and its composition at the atomic level.

“You could say that the MAX IV Laboratory gave us access to microscopy at a level of detail that we have previously never approached. The experiments and the help we got in interpreting the results gave us a fantastically detailed analysis, which now forms the basis for the work on finding effective methods of separating the iron from the organic substances. It is very likely that we will continue to use the MAX IV Laboratory’s resources to move forward in the process. The vision is to be able to recycle and reuse the ferric chloride in the waterworks while producing a completely harmless organic sludge that could be useful in things like soil improvement.”



Sydsvatten delivers drinking water to 900 000 people in Southern Sweden

2.8 Examples of the Case Studies – Home & Personal Care

	NAME	ADRESS	CALL	INDUSTRIAL CATEGORIES	RI
1.	SPEXIMO	LUND, SWEDEN	3rd	HOME & PERSONAL CARE	MAX

COMPANY PROFILE

Name:

SPEXIMO

Address:

Lund, Sweden

Scopes and fields of activity:

Green and sustainable stabilization of emulsions.

EXPERIMENT OVERVIEW

SKINCARE PRODUCTS WITHOUT STICKINESS OR ALLERGENS

Research company Speximo has developed its own method for making stable emulsions without using chemicals. Areas of application include skincare products, medical ointments and food. Experiments at the MAX IV Laboratory provided new knowledge which could form the basis of new, commercially viable products.

The vast majority of skincare products – creams, lotions, sunscreens, etc. – are emulsions which contain both water and oil in microscopically small droplets. In order for the emulsion to remain stable, chemicals are added to the product. This makes many skincare products unusable for people with allergies and it also burdens the environment. Speximo is a research-based company that has developed a completely new method in which ordinary food starch is used as a stabiliser instead of chemicals.

“I worked together with other researchers on a project which dealt with how to use starch to encapsulate bioactive substances in food. We tested starches from many different plants and discovered that quinoa starch was the best at encapsulating oil in water. We had found a new way of making fine emulsions. This led us to other areas of application and cosmetic products were an obvious choice as they are often based on emulsions. This proved more successful than we expected – quinoa-based skin creams are quickly absorbed by the skin, with no stickiness”, says Malin Sjöo a senior lecturer in Food Technology, an expert on

starch and one of Speximo's founders.

At some point, most of us have eaten quinoa, which is used as an alternative to rice or pasta in salads, for example. From the researchers' point of view, what is unique about this South American plant is that the starch particles are uniform and of precisely the right size. This provides an efficient encapsulation of the oil droplets and a smooth and fine product.

THE QUINOA STARCH BARRIER

Currently, Speximo is working on tailoring emulsions for the three areas of Personal Care, Pharmaceuticals and Food. Experiments at the MAX IV Laboratory made it possible to study in detail the barrier that quinoa starch builds against the oil droplets.

"The more we know and understand about the starch barrier, the better we will become at tailoring our products for different areas of application. The experiments at the MAX IV Laboratory gave us the chance to acquire more knowledge about how the starch barrier is affected by various parameters such as heat and storage time", says Malin Sjö. "The experiments enabled us to see what effects various treatments had on the properties of the starch barrier and this can be very useful to us in the further development of our product."

DETECTING PATTERNS OF NANOMATERIALS

Speximo's experiments were conducted at the I911-4 beamline at the MAX IV Laboratory. The beamline is equipped for SAXS (small-angle X-ray scattering) – a method particularly suitable for experiments with nanomaterials, such as Speximo's starch barriers. The nanomaterials can vary and are incorporated in both solids and liquids.

The method got its name from the process in which an X-ray is allowed to scatter in the sample and is then detected by a two-dimensional detector a couple of meters further away. The pattern that emerges on the detector contains information on the nanomaterial in the sample, such as its form and interrelationship.



Speximo has developed their own method for making stable emulsions without chemicals

4. EVALUATION OF THE SCIENCE LINK COOPERATION

At the beginning of 2014 AC Konsultācijas State regional Development Agency of Latvia (one of the Science link partners) present report which covers evaluation of the project's network. The following are the general conclusions of the questionnaires and interviews.

Cooperation of companies with Contact & Consultation Points

- Enterprises cooperated with contact points over the whole lifetime of the project. Their communication was most intense during the competition and while preparing project applications. It was when enterprises received most information from contact points. After experiments contact was less frequent. This was noted as one of the project's weaknesses as enterprises encountered problems when interpreting data.
- The general opinion is that the cooperation with contact points has been good and effective. This indicates that the quality of the information received has not had the most significant effect on their opinion on the cooperation with contact points as such factors as personal contact, frequency of cooperation, etc., have been important too.
- Nearly every enterprise considers contact points being effective and providing added value to the project. This answer has been the most frequent among micro enterprises leading to the conclusion that smaller enterprises are the ones benefiting the most from contact points during preparation and implementation stages of the project. The reason for this is their lack of scientists and labs and well as the non-existent cooperation experience with foreign large-scale research facilities.
- The survey also showed that contact points have given more added value to the enterprises that are 100% locally owned rather than those with foreign ownership. For them scientific cooperation is nothing new.
- The enterprises surveyed propose the following improvements regarding the way contact points operate: strengthening knowledge capacity (staff should possess better knowledge about scientific and research opportunities both in the BSR and Europe), improving advisory support (faster consultation process, more individual consultations, timely information about delays in experiments, etc.).
- A rather common opinion of enterprises is that contact points have been more productive when it came to providing convenient information on opportunities offered by existing large-scale research infrastructures. Less than a half of surveyed enterprises think that contact points provide it to a full extent and less than 30% agree that contact points mostly provide it.

Cooperation of companies with Research Infrastructures

- The quality of support received during (also prior and after) experiments is assessed mainly as good and effective and rather effective.
- The general opinion is that the cooperation with research facilities has been good and effective. The enterprise not satisfied with the cooperation encountered problems with accessibility of research facilities and delays in experiments. Enterprises with a higher number of employees have had a better experience with research. Smaller enterprises have had difficulties with interpretation and understanding of data (result of their lack of scientific staff).
- As to the future cooperation, enterprises would like to receive more information from research facilities on preparation and conducting experiments, as well as more precise deadlines of conducting experiments and receiving results.

Benefits of companies cooperation with Science Link project and plans for the future

- When assessing the effects of the project on their enterprise, the most frequent answer is that the results of experiments have been effective and useful for further work and the project activities have provided new knowledge and ideas. A smaller number of enterprises agree with the statement that infrastructure has been qualitative and matched the needs of their enterprise.
- When assessing the experiment and its impact on the enterprise, the general opinion is that experiments have allowed for taking one or several steps towards development of a specific product and fostered the competitiveness of the product. Approx. 80% of those surveyed agree or rather agree to this.
- A smaller number of enterprises agree that experiments have facilitated development of product innovations. Approx. 50% of those surveyed agree or rather agree with this statement. As development of product innovations has not been the main purpose of this project, this fact is a very good indicator showing the project has a long term impact.
- As the general opinion of enterprises surveyed on the project and its impact is good then almost every enterprise believes similar projects are necessary in the future as well. Especially micro and small-sized enterprises are among those considering such projects necessary in the future. Large-sized enterprises note that similar projects are rather necessary. These differences are related to the limited funding for experiments micro and small-sized enterprises have at their disposal. This was also revealed by the interviews. Therefore such projects are a rather good contribution to their development. Large-sized companies however have their own labs or cooperate with some of them to conduct various experiments.
- The majority of enterprises plan to continue using research facilities and scientific support after the project is finished. There is only one enterprise not planning to use scientific support. The willingness to use scientific support in the future is to a great extent related to the fact that many enterprises have been using them prior to the project as well.

CONCLUSIONS

- In each call the number of applicants increased – there is need for structures like Science Link
- The service structures were established and work well.
- The results of the calls to date illustrate that there is a need for industrial measurements at LSFs from companies in the Baltic Sea region and they need assistance to realise this.
- The local / regional networks have to be strengthened.
- A broad range of industrial categories have already applied – from nanotechnology and electronics to automotive engineering to cosmetics and fertilizers.
- Science Link have attracted a good spread of different sized companies – approximately 70% SMEs (< 200 employees) and 30% large companies (Volkswagen, Volvo, other multinational companies).
- More tailored information is needed.
- The benefit for the LSF is the increased awareness through joint marketing and calls.

Bottle necks

- Knowledge about LSF and methods available is rather limited.
- More consultation locally (academic partners) is needed in the preparatory phase to increase quality of proposa.

SUMMARY

Small and medium sized enterprises (SMEs) are the backbone of Europe's economy: there are 23 million SMEs in Europe representing around 99% of all undertakings, and 57% of them are sole proprietorships. They provide two thirds of total private-sector employment represent 80% of the total job creation and produce more than half of the EU added value.

Therefore SMEs are important for future economic growth. The countries around the Baltic Sea Region (BSR) need more companies that grow and produce goods and services that are competitive on a global market. This is a fact for most European countries and is also highlighted within the work of the European Union.

It has been shown that SMEs cooperating with RI are more competitive and that companies that are cooperating within networks show better performance than companies outside such networks. Still, quite a small proportion of SMEs are working systematically with large scale RIs.

Science Link supports and strengthens international collaboration between SMEs and facilitate new ones with the aim of strengthening the innovation capacity of SMEs and helping them to find new business and market opportunities leading to increased competitiveness and growth.

The strategic idea of Science Link project was to establish and strengthen transnational SMEs' networks and collaboration in order to foster innovation and new business opportunities. This was done through:

- Facilitation of business driven international cooperation between SMEs and RI
- Strengthening innovation via transnational collaboration
- Strengthening competence networks of SMEs in the BSR
- Strengthening the linkages within the region and outside the region.

Science Link project create successful transnational cooperation within network and also with companies which participate in 3 open calls for free beam time. Science Link gave a good opportunity to create long time cooperation between all the stackholders.

In the Baltic Sea Region Science Link:

- Build up R&D network supporting innovation
- Cover research costs of SME's at RI
- Provide RIs with personnel taking care of industrial needs of Small/Medium Enterprises (SMEs) and others – Industrial Liason Officers
- Establish local contact points closely collaborating with industry and academic partners (Universities and R&D Institutes)
- Share relevant information and provide training for SME's
- Enable simplified access to world class research centres, novel research methods and data treatment, etc
- Increase the share of mutually useful cooperation of public and private sectors in innovation, education and R&D