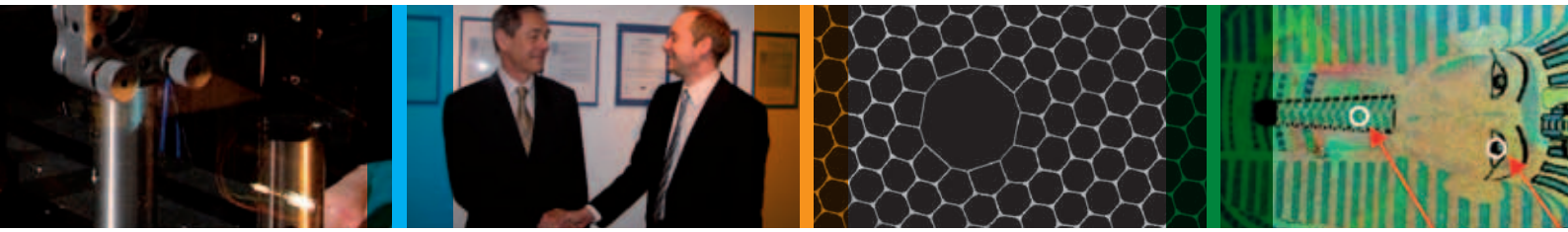
ANNUAL REPORT AND STATEMENT OF INCOME FOR 2009

DANISH FUNDAMENTAL METROLOGY



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DFM's scientific research results in new knowledge, measurement techniques and standards, which support the need for accurate measurements required by Danish Industry and Authorities.

The services offered are high-level calibrations and reference materials, courses related to metrology and consultancy.

DFM has a special role in developing measurement capabilities, needed by small and medium sized high-tech companies in order for them to evolve and prosper.

DFM works to ensure global confidence in Danish metrological services, which is critical for competing in the global market place.

Annual report 2009 edited by
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Metrologi har været et fokusområde for Rådet for Teknologi og Innovation i perioden 2007 - 2009. Dette har muliggjort en række nye initiativer, herunder deltagelse i et fælleseuropæisk metrologiforskningsprogram, i klimarelaterede metrologiprojekter og i en styrkelse af dansk metrologis organisation og internationale engagement. Disse initiativer er i det forløbne år afsluttet og forankret i DFM's strategi og daglige arbejde.

DFM fik ny direktør den 15. juni 2009, idet DFM's direktør gennem 23 år valgte at trække sig tilbage.

Den nye ledelse har udarbejdet en strategiplan for perioden 2010 - 2012. Der er i strategien lagt stor vægt på at styrke selskabets eksterne netværk med henblik på at øge forståelsen for det danske samfunds nuværende og fremtidige metrologibehov, samt at skabe et stærkt fundament for styrket forskningssamarbejde med universiteter og andre GTS institutter.

Selskabets indsats indenfor de nuværende styrkeområder elektrokemi, akustik, optik og nanometrologi øges yderligere med særlig fokus på de samfundsrelevante områder sundhed, energi og klima.

DFM's rolle i forhold til Danmarks bidrag til den internationale metrologi vil blive bevaret gennem en fortsat aktiv forskningsindsats. Arbejdet med udvikling af den danske metrologi og metrologistruktur vil fortsætte uændret, blandt andet gennem støtte til Forskning og Innovationsstyrelsens og Sikkerhedsstyrelsens metrologiarbejde samt ved deltagelse i det fælles Metrologiudvalg.

DFM har gennemgået en organisationsændring, og der er indført målstyring og ændrede beslutningskompetencer, således at selskabets struktur og processer på bedre vis støtter den valgte strategi.

På basis af strategiplanen har Videnskabsministeriet godkendt DFM som GTS institut for perioden 2010 - 2012. Der har fra Rådet for Teknologi og Innovations side været stor opbakning til den valgte strategi, idet DFM's resultatkontrakt for de kommende 3 år er øget væsentligt. Det er glædeligt, at der er skabt et solidt grundlag for styrkelse af metrologien i de kommende år til gavn for det danske samfund.

Årets resultat før skat blev –349 tkr, hvilket overordnet vurderes at være utilfredsstillende. Underskuddet skyldes primært en reduktion i de udenlandske metrologiopgaver, der igennem en årrække har udgjort en væsentlig del af den kommercielle omsætning. Kalibreringsindtægterne, der er en god indikator for metrologibehovet i det danske samfund, udviser fortsat en stabil vækst.

Som led i den nye strategi er der igangsat en række initiativer med det langsigtede formål at øge den kommercielle omsætning indenfor områder af betydning for danske virksomheder og danske myndigheder. Det er således ledelsens forventning, at der kan opnås et positivt resultat for 2010.

Selskabets positive udvikling på forskningssiden er fortsat i 2009, og der er opnået øgede nationale og europæiske bevillinger blandt andet indenfor måling af nanopartikler og anvendelse af elektrokemi i forbindelse med bio-brændstoffer.

Årsrapporten indeholder faktuelle oplysninger om DFM og dansk metrologi som helhed. Den fortæller nogle udvalgte historier, som belyser metrologiens værdi for et moderne samfund, både som støtte til innovation og som en del af samfundets grundlæggende teknologiske infrastruktur.

Steen Konradsen
Bestyrelsesformand

Michael Kjær
Adm. Direktør

The following is a translation of an original Danish document. The original Danish document shall be the governing document for all purposes, and in case of any discrepancy the Danish wording shall be applicable.

Metrology has been a strategic focal point for the Danish Council for Technology and Innovation in the period 2007 to 2009. As a result, new initiatives were launched, which included participation in the European Metrology Research Programme (EMRP), new climate related metrology projects and strengthening of the organisation and international engagement of Danish Metrology.

A new managing director began June 15, 2009 when the previous director chose to retire after 23 years in office.

The new management developed a strategy plan for the period 2010 - 2012. The focus points of the strategy are strengthening DFM's external network thereby increasing the understanding of the current and future metrology needs of the Danish society and to create a strong foundation for increasing research collaboration with Universities and the Advanced Technology Group (GTS).

DFM's research efforts within the primary competence areas electrochemistry, acoustics, optics and nano-metrology will be increased, with particular focus on health, energy and climate change. The contribution to international metrology will continue through DFM's active research effort.

DFM will maintain its support to the development of Danish metrology and metrology infrastructure in collaboration with relevant Danish Authorities.

The organisational structure and the business processes were altered in order to support the new strategy.

Based on the strategy plan the Ministry of Science, Technology and Innovation approved DFM as a member of the Advanced Technology Group (GTS), and our contract with the Danish Council for Technology and Innovation increased substantially.

Retiring director Kim Carneiro greets his sucessor Michael Kjær

A solid foundation for Danish metrology has now been established for the benefit of society.

The pre tax accounting income for the year was -349 thousand DKK, which is unsatisfactory. The deficit was mainly caused by a reduction in foreign metrology consultancy tasks, which in previous years made up a substantial part of the revenue. Calibration income continues to show stable growth. As part of the new strategy, initiatives have been launched with the goal of increasing commercial turnover within areas relevant to Danish Industry and Authorities. The management expects that 2010 will show a profit.

The positive development within research continued in 2009 and increased National and European funding was obtained. This includes projects on measurement of nano-particles and use of electrochemistry in relation to bio-fuels.

The annual report contains factual information about DFM and Danish metrology and report selected stories highlighting the value of metrology in a knowledge-based society.

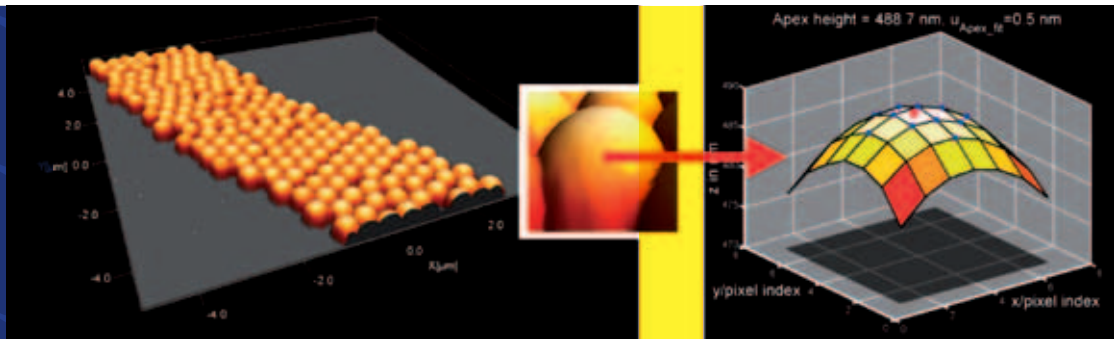
Steen Konradsen
Chairman of the Board

Michael Kjær
CEO

NANOPARTICLES – NOW CERTIFIED BY DFM

Bottle containing suspension of nanoparticles with certified diameter.

Dr. Kai Dirscherl extracting a sample of nanoparticles from a reference bottle.



Microscopic image of 500-nm polystyrene particles analysed particle by particle.

Spherical particles suspended in a liquid are used as a reference material for calibration of particle measurement instruments, which are applied to validate clean rooms in the pharmaceutical and semi-conductor industry. DFM has responded to the needs expressed by several Danish companies and has obtained accreditation for the measurement and certification of particle diameters in such reference materials.

Particle measurement instruments are typically calibrated with spherical particles of a well known-size; such particles are known as reference particles. These spherical particles are commercially available. However, the average diameter of a batch and the related size distribution reported by the manufacturer is often not well documented, and the traceability of the particle diameter to the meter definition is often missing.

DFM now offers bottles with dispersions of polystyrene particles measured and certified under an accreditation from DANAK, the Danish accreditation body. These bottles contain 15 ml of dispersed particles. The mass concentration of the nanospheres in the dispersion is typically 1%. DFM can offer and certify samples of nanoparticles ranging from 100 nanometre up to 5 000 nanometre in steps of 100 nanometre. The particle diameters can be determined with an expanded uncertainty ranging from 5 nanometre for the smallest up to 50 nanometre for the largest diameters in that range.

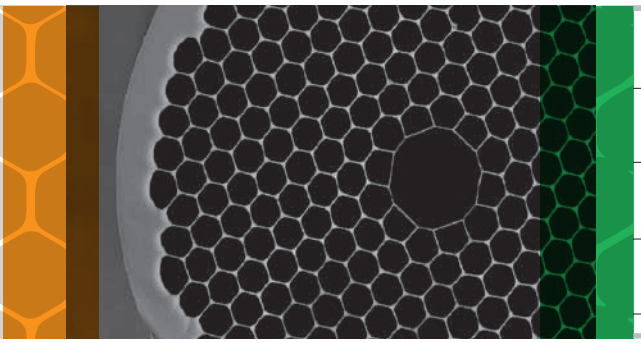
The certification is based on three-dimensional images of particle samples obtained with an Atomic Force Microscope (AFM). Each image typically contains 100 to 200 particles. In a subsequent image analysis, the particle diameter distribution is calculated. The certified mean particle diametre and its expanded uncertainty follow the diameter distribution along with uncertainty contributions from the measurement method and the process of sampling from the bottle.

The certification of reference particles is the first step at DFM in the establishment of a national primary laboratory for nanoparticle measurements, including particle counting. The importance of such a laboratory has increased rapidly. The exposure to nanoparticles and the related health risks have been pointed out in literature, and as a consequence the need for monitoring nanoparticles in the environment is growing rapidly.

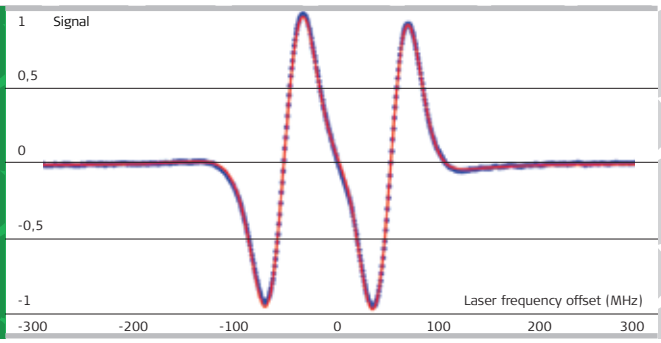
NANOPARTICLES

Combustion processes, such as those taking place in e.g. car engines or central heating boilers, emit particles, often visible as smoke. Once these airborne particles are smaller than 200 nanometre and have reached the lungs' alveoli, they can enter our bloodstream and cause harm to living tissue. Particle measuring instrumentation, e.g. used in traffic monitoring, needs to be sufficiently accurate in order to correctly detect the harmful smaller particles. Also clean room based production lines rely on an effective surveillance of the particle concentration in order to guarantee high level of product quality.

NEW APPROACH TO HIGH-RESOLUTION SPECTROSCOPY



Cross-section of a hollow core photonic bandgap fibre. NKT Photonics is acknowledged for kind permission to use the image.



Two close-lying absorption lines in ammonia near a wavelength of 1532 nm have been resolved by spectroscopy in a hollow-core fibre. The line shape is a result of the modulation technique applied for increasing the signal-to-noise ratio. The solid red line is a fit to the theoretical line shape.

DFM has developed new techniques for measuring spectroscopic properties of ammonia molecules. The results add to the existing knowledge about ammonia and have relevance for spectroscopy-based ammonia sensors.

Ammonia is a naturally occurring gas, which is released for example in connection with pig breeding. In addition, ammonia is produced and used in refrigeration and as feedstock for other nitrogen fertilizers. It is potentially harmful to human health and to the environment, and it is important to have methods for measuring the presence and the quantity of ammonia. One method is spectroscopic measurements, where the interaction between radiation and ammonia molecules is used in quantifying the ammonia concentration. However, such spectroscopic techniques rely on preexisting knowledge about the structure of the molecular spectra. This information does not always exist and the work at DFM contribute to further knowledge.

The techniques developed at DFM use a 3 m long hollow-core photonic bandgap fibre (HC-PBF) filled with ammonia gas. The very thin fibre is designed to guide light at wavelengths around 1500 nm. High intensity is obtained, as the light remains tightly focused while propagating in the narrow fibre core. Thus, the use of the gas-filled fibres provides very efficient interaction between intense light and molecules over long path lengths.

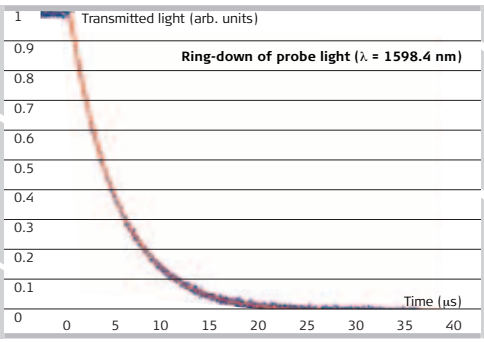
In one experiment, two counter-propagating laser beams are used in the ammonia-filled fibre. The high light intensity results in a phenomenon known as "optical saturation", and detection of the optical radiation transmitted through the fibre reveals absorption lines much more narrow than in conventional absorption spectroscopy. New absorption lines in ammonia were identified as a result of the increased resolution.

In a second experiment, DFM places the fibre inside a one-meter long tube guiding microwaves with frequencies around 20 GHz. The simultaneous interaction between microwaves, optical radiation, and ammonia molecules results in so-called microwave-optical double resonance spectra. By measuring the transmitted optical radiation while tuning the microwave- and optical frequencies individually, additional knowledge about ammonia transitions were collected and new assignments of absorption lines were accomplished.

HOLLOW CORE PHOTONIC BANDGAP FIBRES

A standard optical fibre, which is used in optical tele-communication, has a glass core with a diameter of typically 10 micrometer. A glass cladding of lower density surrounds the core. The light is guided in the core due to the material density difference. In a hollow-core photonic bandgap fibre the glass cladding is replaced by a periodic structure of glass and hollow regions. The core, which has a diameter similar to that of a standard fibre, is hollow as well. The core is normally filled by atmospheric air, but it can be filled with specific gasses. DFM use fibres manufactured by NKT Photonics A/S, a world-leading producer of photonic bandgap fibres.

CAVITY RING-DOWN SPECTROSCOPY FOR TRACE GAS MONITORING



When the laser is switched off, the field inside an optical resonator decays exponentially. The above ring-down curve was recorded using a preliminary test setup at DFM.

Dr. Niels Kjærgaard adjusting the measurement setup

DFM is extending its spectroscopic facility by introducing a cavity-enhanced technique for high accuracy molecular spectroscopy. The method is very sensitive and suitable for trace gas detection. In addition, it has the unique feature of being able to detect two molecular species simultaneously.

Conventional laser absorption spectroscopy is a well-established tool for measuring the concentration of specific molecular species. The attenuation of light due to molecular absorption is measured. After passing through the gas the light intensity will decrease with the number of molecules present. For low gas concentrations or short optical path lengths the signal to noise ratio will be poor. However, by placing the gas sample between two mirrors, light can be reflected back and forth many times, effectively increasing the optical path length through the gas. In cavity ring-down spectroscopy, the mirror distance is arranged such that the laser frequency is in resonance with a standing wave between the mirrors in addition to being in resonance with a molecular absorption line. The mirrors are said to form a resonator or a cavity.

When light is coupled into the resonator, optical power will build up as a result of light bouncing back and fourth between the mirrors – more than 10.000 times in the setup implemented at DFM. If the laser light is suddenly turned off, the power in the resonator will decay exponentially with time.

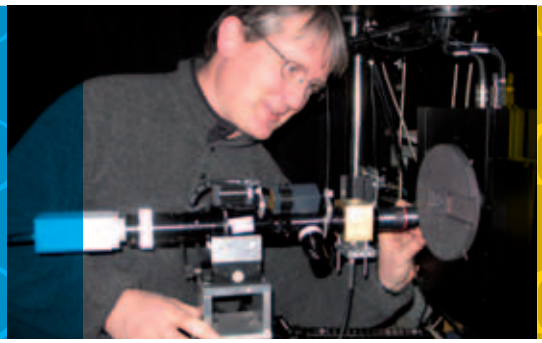
OPTICAL CAVITY

An optical cavity is a configuration of mirrors forming a standing wave resonator for light. For high reflective mirrors, a photon can travel an effective optical path length of several kilometers, while the cavity has a tractable physical dimension of some centimeters.

This "ring-down" can be monitored by a photodetector. The decay will happen more rapidly if absorbing molecules provide damping. Hence, an accurate determination of the decay time reveals the concentration of absorbing molecules

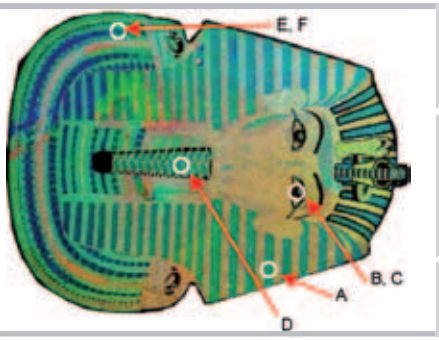
The DFM implementation of cavity ring-down spectroscopy features a novel experimental scheme, where the probe laser frequency is rapidly toggled between two absorbing features and the corresponding ring-down times are recorded. This opens up the possibility of accurately determining the relative abundance of two components of a gas as, e.g., the ratio of $^{13}CO_2$ to $^{12}CO_2$. Such ratios are of considerable interest in relation to climate, agriculture, health care and authentication.

METROLOGY APPLIED TO HOLOGRAMS



Set-up for accurate measurement of the optical appearance of the holograms operated by Dr. Poul-Erik Hansen

Point	Thumb-nail	Pitch (nm)	Line amplitude (nm)
A		747 ± 10	~ 235
C		695 ± 10	~ 230
D		722 ± 10	~ 225
E		898 ± 10	~240
F		724 ± 10	~270
B		Roughness ~ 5.2 nm	



The small thumbnails in the table are atomic force microscopy images of the grating structure on a nickel hologram master. The actual position of the investigated grating areas A, B, ... , F are marked on the images of the hologram to the right. The period of the different gratings ranges from 695 nm to 747 nm (1000 nm = 1 µm = 0,001 mm) and they have different orientations. The height ranges from 225 nm to 270 nm. One area does not have any grating structure, but the roughness of the surface is approximately 5.2 nm. These quantitative measurements can prove the physical quality of the hologram masters surface.

A technique for printing holograms patented by two Danish companies has created a need for a quality control method in which printed holograms are compared with reference holograms. In a joint project with one of the companies, DFM provides the necessary measurement tools.

Holograms are seen in many places; in particular they appear on credit cards, banknotes and on branded goods, such as CDs, DVDs and software packaging. Holograms serve to make an item stand out visually and to authenticate an item as being genuine. Being virtually impossible to copy, holograms provide a powerful tool against counterfeiting.

Traditionally, surface relief holograms are produced by stamping a nickel hologram master into a thin layer of thermoplastic, which is then mounted on a reflecting aluminium foil. The Danish companies Stensborg A/S and Nilpeter A/S have developed and patented a cassette system, which makes it possible to print holograms directly on paper or foils in a conventional printing process. The process is called HOLOPRINT™.

In order to ensure that the printed holograms meet the expectations of the end users, a new quality control method was requested by the patent owners. In collaboration with Stensborg A/S, DFM has therefore launched a project in which the optical appearance of printed holograms will be compared to that of reference holograms. DFM has built an optical system for recording the optical images of holograms, and methods for comparing such images are being developed.

MICROSTRUCTURE

The microstructure of a surface relief hologram can be seen in a microscope such as an atomic force microscope (AFM). Each hologram consists of small areas with very fine lines on the surface. The density of the lines is more than one thousand lines per millimetre, and because of this line density the microstructure becomes optically active thus creating a holographic image. Changes in sparkly colours and shapes are seen when the holograms are moved back and forth in ambient light. Copying a hologram is extremely complicated if not impossible.

In a further step of the project, the partner will try to establish a standard for hologram classifications. This will be achieved by correlating the surface relief structure of a master hologram with its optical appearance; especially the influence of defects will be investigated. The local pattern of the master hologram will be measured by atomic force microscopy.

This project is supported by the Danish Agency for Science, Technology and Innovation.

SELF-CLEANING FLOORS AND WINDOWS

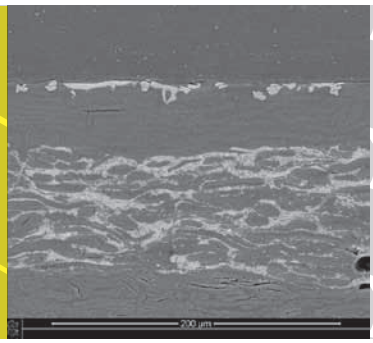


Figure 1: SEM picture showing clusters of titanium oxide in the top layer of a floor sample. It is noticed that the titanium dioxide has formed clusters in the top layer and is not spreading homogeneously over the entire surface layer of the floor as desired.

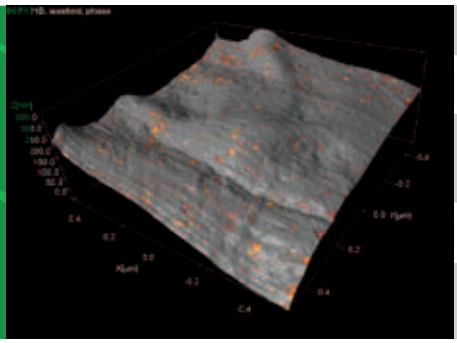


Figure 2: AFM picture showing clusters of titanium oxide in the top layer of a floor sample, orange areas.

DFM is part of a project concerned with the detailed understanding and improvement of self-cleaning floor and window samples. Adding photocatalytic nano-clusters to conventional samples generates this phenomenon. Measurements require the use of instrumentation suitable for identifying particles at the nano- and micro scale level.

DFM and FORCE Technology has investigated floor and window samples with the purpose of finding, identifying and measuring the adhesion of active titanium dioxide particles by use of atomic force microscope (AFM) and scanning electron microscope (SEM).

How does it work?

Floor and window samples have been modified with titanium dioxide, which is a photocatalytic active material. The floor samples are produced by compressing layers of materials, and the photocatalytic material is added to the surface layer. The window samples have had photocatalytic material polished onto the glass.

Measurement techniques

The AFM, at DFM, is used to measure the shape of the added clusters with high accuracy and also to apply a force to the clusters. The latter is an indication of how strongly the clusters adhere to the surface. It has been found that the binding of the cluster to the surface exceeds the force that could be applied by the AFM. At FORCE Technology the SEM is used for locating the clusters and chemically identify them. A chemical analysis of the samples could identify the presence of titanium and oxygen.

PHOTOCATALYSIS

Photocatalysis is a phenomenon by which a relatively small amount of light-absorbing material, called a photocatalyst, changes the rate of chemical reaction without itself being consumed. In our case the photocatalyst reacts with water such that water form a perfect film on the surface, which make it easy to remove dirt from the surface.

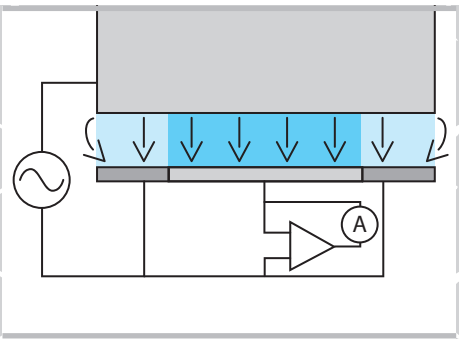
An iterative process consisting of alternate detailed measurements as described and stepwise variation in the sample production has lead to an improved product.

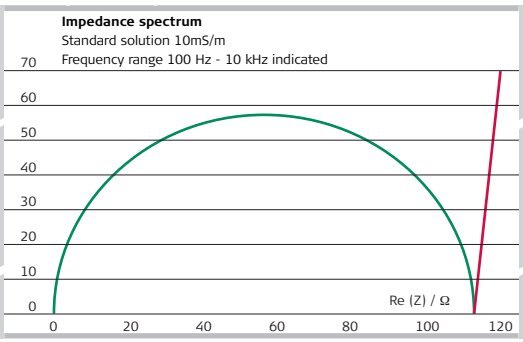
Further development

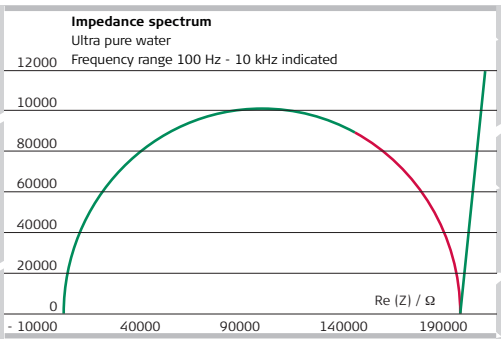
The company participating in the project, Photocat, has received valuable insight into the photocatalytic process taking place in the tested floor and window samples and has gained experience in how to improve the production process. The technology will make cleaning of floors and windows much easier. The documented functionality will lower the time of market and entry barrier for the products.

This work has been supported by the Danish Agency for Science, Technology and Innovation through the Innovation Consortia Functional Embedded Nano and Microstructures (FINST).

ULTRAPURE WATER – HOW PURE IS IT?







A cut-through of a coaxial cell for measurement of ultrapure water. Guard-sections at each end eliminate the stray currents and only the purely radial current in the center-section is measured. Polarisation effects at the electrodes are eleminated by analysing the measured impedance.

DFM has designed a new cell for measuring the conductivity of ultrapure water. This is a first step in establishing traceability on measurement of ion activity in clinical chemistry.

Purity is a measure of the quality of water for a variety of applications: drinking water, water used in food and pharmaceuticals, cooling water and water used in other industrial processes. Requirements to the maximum content of foreign substances, such as salts, depend on the application. As the presence of ions in water increases the conductivity of water dramatically, the conductivity is often used as a measure of the purity of water.

Even the purest water, which does not contain any substances other than H2O, has a non-zero conductivity that defines the lower limit on a water purity scale based on conductivity. Unfortunately, the measurement of conductivity of very pure water – also known as ultrapure water – is not fully understood yet. DFM participates in a European Metrology Research Project entitled "Traceable measurements for biospecies and ion activity in clinical chemistry", where one work package is devoted to solving this measurement problem. To measure low levels of ion activity it is necessary to quantify the purity of the water used more precisely.

In a primary measurement, the water conductivity is derived from the impedance versus frequency measured over two electrodes in a measurement cell filled with water. The geometry of the electrodes and the surrounding water defines a cell constant that is used to derive the water conductivity from the measured impedances. DFM has designed a new measurement cell for which the cell constant has been calculated from its geometry and dimensions. Measurements on ultrapure water with this cell will be used to test different models for the polarisation effect at the water-electrode boundary – an effect that is necessary to better understand how to achieve the precision required when measuring conductivity of ultrapure water in the presence of low level ionic contamination.

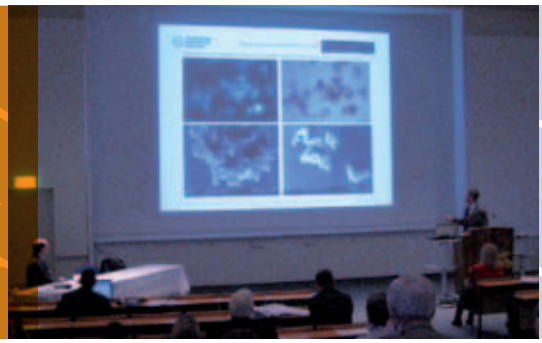
The project is co-funded by the Danish Council for Technology and Innovation, and the European Commission under Grant Agreement No. 217257.

IMPEDANCE

When a static voltage V is applied over the two ends of a conducting wire, a current I will flow through the wire; this current will be proportional to the voltage, and the constant R = V/I is called the resistance of the wire. If the wire is cut and two electrodes are inserted, application of a static voltage to this circuit will create a current that vanishes as positive and negative charges are building up on the respective electrodes. If an alternating voltage is applied to the circuit, an alternating current will be generated; the amplitudes of voltage and current will be proportional, but voltage and current will be shifted in time. Mathematically, this fact can be described by the relation V/I = Z, where V and I are complex numbers describing magnitude and phase of the alternating voltage and current, and where Z is the so-called impedance of the circuit. The real and imaginary parts of Z = R + iX are called the resistance R, respectively the reactance X of the circuit: Re[Z] = R, Im[Z] = X. In general, the impedance of a circuit changes with the frequency of the alternating current. A measured impedance spectrum, i.e. a measurement of impedance versus frequency, can be used to infer useful information about the properties of circuit elements, including a set of electrodes in contact with water.

SETTING THE STRATEGY FOR EUROPEAN NANOMETROLOGY

Partners in the EU-supported project Co-Nanomet



Co-founder and Sales Manager Dr. Anders Blom from QuantumWise is giving at talk at the European Nanometrology Workshop 19th to 20th November 2010, Braunschweig, Germany, co-organized by DFM. The workshop brought together over 140 leading experts from industry, research institutes, national metrology institutes and regulatory bodies to review the current state of the art and the future metrology needs of European Nanotechnology Industry.

DFM is taking a leading part in formulating the long term strategy for nanometrology in Europe. Fourteen partners within the EU-supported project Co-Nanomet have expressed the needs for a coordinated nanometrology in the member states and have analysed the current strengths and weaknesses of the supporting metrology.

The European Commission launched the Framework Program 7 (FP7) named "Coordination Action" in 2008. Funded by this program, the pan-European project "Co-Nanomet" was initiated in 2009. The purpose of Co-Nanomet is to establish a coordinated European strategy for metrology at the nano-scale in support to science, innovation and technology. The European Society for Precision Engineering and Nanotechnology, euspen, is the leading partner, seconded by DFM. The Co-Nanomet consortium is made up of fourteen expert organisations in the fields of nanometrology, nanotechnology, technology transfer and specialised training with a geographical distribution as illustrated above. The project period covers 2009-2010.

A milestone achieved in the first year was the report "Nanometrology strategy paper". Based on the input from a questionnaire sent to more than 30 international expert organisations, it covers topics such as the current status, capabilities and limitations of state-of-the-art techniques and instrumentation. Together with the projected future needs in the field of nanometrology, a strategy is defined. DFM played a key role during the process of fact finding and strategy formulation.

Another core activity of Co-Nanomet is the formation of five European Nanometrology Action Groups. Their aim is to address the need for the establishment of a coordinated dissemination of metrology techniques to industry. Under this process, the traceability to internationally recognised national standards must be maintained. The action groups are formed around the most challenging topics in nanometrology today: Engineered nanoparticles, Nanobiotechnology, Thin films and structured surfaces, Critical dimension and scanning probe techniques, and Modelling and simulation.

On invitation from DFM, The Danish nanotechnology company QuantumWise A/S participates in the Co-nanomet action group on Modelling and Simulation at the Nanoscale. QuantumWise A/S was founded in 2008 by CEO Dr. Kurt Stokbro. The company develops and sells the software package "Atomistix ToolKit", a point-and-click program for simulation and analysis of physical and chemical properties of nanoscale devices. "QuantumWise sees the activity as important for defining the future nanotechnology activity across Europe and would like to see that the area is properly covered", says co-founder Dr. Anders Blom.

ÅRSREGNSKAB FOR PERIODEN 2009-01-01 TIL 2009-12-31

LEDELSESPÅTEGNING

Bestyrelse og direktion har dags dato behandlet og godkendt årsrapporten for regnskabsåret 1. januar 2009 - 31. december 2009 for Dansk Fundamental Metrologi A/S.

Årsrapporten er aflagt i overensstemmelse med Årsregnskabsloven.

Det er vores opfattelse, at årsregnskabet giver et retvisende billede af Dansk Fundamental Metrologi A/S' aktiver, passiver og finansielle stilling pr. 31. december 2009 samt af resultatet af selskabets aktiviteter og pengestrømme for regnskabsåret 1. januar - 31. december 2009.

Det er endvidere vores opfattelse, at ledelsesberetningen indeholder en retvisende redegørelse for de forhold beretningen omhandler.

Årsrapporten indstilles til generalforsamlingens godkendelse.

Kgs. Lyngby, den 24. marts 2010

DIREKTION

Michael Kjær
Direktør

BESTYRELSE

Lars Barkler

Knut Conradsen
Næstformand

René Logie Damkjer

Kai Dirscherl
Medarbejderrepræsentant

Steen Konradsen
Formand

Jan Conrad Petersen
Medarbejderrepræsentant

Søren Stjernqvist

REVISIONSPÅTEGNING

DEN UAFHÆNGIGE REVISORS PÅTEGNING

Til aktionæren i Dansk Fundamental Metrologi A/S
Vi har revideret årsregnskabet for Dansk Fundamental Metrologi A/S for regnskabsåret 1. januar - 31. december 2009, side 15-19. Årsregnskabet omfatter anvendt regnskabspraksis, resultatopgørelse, balance, pengestrømsopgørelse og noter. Årsregnskabet udarbejdes efter årsregnskabsloven.
Vi har i tilknytning til revisionen gennemlæst ledelsesberetningen, der udarbejdes efter årsregnskabsloven, og afgivet udtalelse herom.

Ledelsens ansvar
Ledelsen har ansvaret for at udarbejde og aflægge et årsregnskab, der giver et retvisende billede i overensstemmelse med årsregnskabsloven. Dette ansvar omfatter udformning, implementering og opretholdelse af interne kontroller, der er relevante for at udarbejde og aflægge et årsregnskab, der giver et retvisende billede uden væsentlig fejlinformation, uanset om fejlinformationen skyldes besvigelser eller fejl, samt valg og anvendelse af en hensigtsmæssig regnskabspraksis og udøvelse af regnskabsmæssige skøn, som er rimelige efter omstændighederne. Ledelsen har endvidere til ansvar at udarbejde en ledelsesberetning, der indeholder en retvisende redegørelse i overensstemmelse med årsregnskabsloven.

Revisors ansvar og den udførte revision
Vores ansvar er at udtrykke en konklusion om årsregnskabet på grundlag af vores revision. Vi har udført vores revision i overensstemmelse med danske revisionsstandarder og god offentlig revisionsskik jf. revisionsinstruks for revisor ved Godkendte Teknologiske Serviceinstitutter (GTS). Disse standarder kræver, at vi lever op til etiske krav samt planlægger og udfører revisionen med henblik på at opnå høj grad af sikkerhed for, at årsregnskabet ikke indeholder væsentlig fejlinformation.

En revision omfatter handlinger for at opnå revisionsbevis for de beløb og oplysninger, der er anført i årsregnskabet. De valgte handlinger afhænger af revisors vurdering, herunder vurderingen af risikoen for væsentlig fejlinformation i årsregnskabet, uanset om fejlinformationen skyldes besvigelser eller fejl. Ved risikovurderingen overvejer revisor interne kontroller, der er relevante for selskabets udarbejdelse og aflæggelse af et årsregnskab, der giver et retvisende billede, med henblik på at udforme revisionshandlinger, der er passende efter omstændighederne, men ikke med det formål at udtrykke en konklusion om effektiviteten af selskabets interne kontrol. En revision omfatter endvidere stillingtagen til, om den af ledelsen anvendte regnskabspraksis er passende, om de af ledelsen udøvede regnskabsmæssige skøn er rimelige samt en vurdering af den samlede præsentation af årsregnskabet.

Det er vores opfattelse, at det opnåede revisionsbevis er tilstrækkeligt og egnet som grundlag for vores konklusion.

Revisionen har ikke givet anledning til forbehold.

Konklusion
Det er vores opfattelse, at årsregnskabet giver et retvisende billede af selskabets aktiver, passiver og finansielle stilling pr. 31. december 2009 samt af resultatet af selskabets aktiviteter og pengestrømme for regnskabsåret 1. januar - 31. december 2009 i overensstemmelse med årsregnskabsloven.

Udtalelse om ledelsesberetningen
Vi har i henhold til årsregnskabsloven gennemlæst ledelsesberetningen. Vi har ikke foretaget yderligere handlinger i tillæg til den gennemførte revision af årsregnskabet. Det er på denne baggrund vores opfattelse, at oplysningerne i ledelsesberetningen er i overensstemmelse med årsregnskabet.

København, den 24. marts 2010
KPMG, Statsautoriseret Revisionspartnerselskab

Peter Gath, statsaut. revisor

Charlotte Formsgaard, statsaut. revisor

ANVENDT REGNSKABSPRAKSIS

Generelt
Årsrapporten for Dansk Fundamental Metrologi A/S (DFM) for 2009 er aflagt i overensstemmelse med årsregnskabslovens bestemmelser for klasse B-virksomheder. Herudover har selskabet frivilligt tilvalgt følgende regler for klasse C-virksomheder:

+ Aflæggelse af ledelsesberetning.
+ Udarbejdelse af pengestrømsopgørelse.

Årsregnskabet er aflagt efter samme regnskabspraksis som sidste år. Regnskabet er baseret på selskabets bogføring, men tallene er angivet i tusinde af kroner. Der kan derfor forekomme tilsyneladende afrundingsfejl ved sammentællingerne.

Omregning af fremmed valuta
Transaktioner i fremmed valuta omregnes til transaktionsdagens kurs. Valutadifferencer, der opstår mellem transaktionsdagens kurs og kursen på betalingsdagen, indregnes i resultatopgørelsen som en finansiel post. Tilgodehavender, gæld og andre monetære poster i fremmed valuta omregnes til balancedagens valutakurs. Forskellen mellem balancedagens kurs og kursen på tidspunktet for tilgodehavendets eller gældens opståen indregnes i resultatopgørelsen under finansielle indtægter og omkostninger.

RESULTATOPGØRELSEN

Indtægter
Indtægter fra forskningskontrakter indregnes i takt med at arbejdet udføres, hvorved nettoomsætningen svarer til salgsværdien af årets udførte arbejder (produktionsmetoden). Nettoomsætningen indregnes, når de samlede indtægter og omkostninger på forskningskontrakten og færdiggørelsesgraden på balancedagen kan opgøres pålideligt, og det er sandsynligt, at de økonomiske fordele, herunder betalinger, vil tilgå selskabet. I projekter, hvor DFM er tilskudsmodtager på vegne af et konsortium, indregnes tilskudsbeløbet som omsætning, i det omfang DFM på vegne af konsortiet er økonomisk ansvarlig over for tilskudsgiver; partneres omkostninger fradrages i udlæg. I projekter hvor DFM ikke er ansvarlig for partneres ydelser indregnes kun den forholdsmæssige andel af kontraktsummen, som direkte tilfalder DFM, i omsætningen. Indtægter fra resultatkontraktaktiviteter indtægtsføres i det år tilskuddene modtages, som er sammenfaldende med den tilladte anvendelsesperiode.

Skat af årets resultat
Årets skat, som består af årets aktuelle skat og forskydning i udskudt skat, indregnes i resultatopgørelsen med den del, der kan henføres til årets resultat, og direkte i egenkapitalen med den del, der kan henføres til bevægelser direkte i egenkapitalen.

BALANCEN

Materielle anlægsaktiver
Materielle anlægsaktiver måles til kostpris med fradrag af akkumulerede afskrivninger. Afskrivningsgrundlaget er kostpris med fradrag af forventet restværdi efter afsluttet brugstid. Kostprisen omfatter anskaffelsesprisen samt omkostninger direkte tilknyttet anskaffelsen indtil det tidspunkt, hvor aktivet er klar til brug.

Udstyr og inventar afskrives lineært over 3-7 år til en restværdi på 0-20% af anskaffelsesprisen. I anskaffelsesåret afskrives for et helt år uanset anskaffelsestidspunktet.

Indretning af lejede lokaler afskrives lineært baseret på aktivernes forventede brugstid, der regnes som 15 år fra 2002.

Udstyr og inventar overdraget 1. januar 2006 fra den selvejende institution Dansk Institut for Fundamental Metrologi afskrives med en særlig afskrivningsprofil over 6 år til en restværdi på 20%.

Anskaffelser med en anskaffelsessum på under 20 000 kr., udstyr anskaffet for offentlige tilskudsmidler samt mindre kontorinventar indregnes i resultatopgørelsen i anskaffelsesåret. Fortjeneste eller tab ved afhændelse af materielle anlægsaktiver opgøres som forskellen mellem salgspris med fradrag af salgsomkostninger og den regnskabsmæssige værdi på salgstidspunktet. Fortjeneste eller tab indregnes i resultatopgørelsen under afskrivninger.

Igangværende arbejder
Igangværende arbejder for fremmed regning måles til salgsværdien af det udførte arbejde omfattende medgået tid samt afholdte udlæg. Salgsværdien måles på baggrund af færdiggørelsesgraden på balancedagen og de samlede forventede indtægter på det enkelte igangværende arbejde.

Når salgsværdien på en forskningskontrakt ikke kan opgøres pålideligt, måles salgsværdien til de medgåede omkostninger eller nettorealisationsværdien, såfremt denne er lavere. Det enkelte igangværende arbejde indregnes i balancen under tilgodehavender eller gældsforpligtelser afhængig af nettoværdien af salgssummen med fradrag af àconto faktureringer og forudbetalinger. Omkostninger i forbindelse med salgsarbejde og opnåelse af kontrakter indregnes i resultatopgørelsen i takt med, at de afholdes.

Tilgodehavender
Tilgodehavender måles til amortiseret kostpris. Der nedskrives til imødegåelse af forventede tab efter en individuel vurdering af tilgodehavender.

Selskabsskat og udskudt skat
Aktuelle skatteforpligtelser og tilgodehavende aktuel skat indregnes i balancen som beregnet af årets skattepligtige indkomst, reguleret for skat af tidligere års skattepligtige indkomster samt for betalte acontoskatter.

Udskudt skat måles efter den balanceorienterede gældsmetode af alle midlertidige forskelle mellem regnskabsmæssige og skattemæssig værdi af aktiver og forpligtelser.

Udskudte skatteaktiver, herunder skatteværdien af fremførselsberettigede skattemæssige underskud, måles til den værdi, hvortil de forventes at kunne realiseres, enten ved udligning i skat af fremtidig indtjening eller ved modregning i udskudte skatteforpligtelser inden for samme juridiske skatteenhed. Eventuelle udskudte nettoaktiver måles til nettorealisationsværdi.

Udskudt skat måles på grundlag af de skatteregler og skattesatser, der med balancedagens lovgivning vil være gældende, når den udskudte skat forventes udløst som aktuel skat. Ændring i udskudt skat som følge af ændringer i skattesatser indregnes i resultatopgørelsen.

Pengestrømsopgørelse
Pengestrømsopgørelsen viser selskabets pengestrømme fordelt på drifts-, investerings- og finansieringsaktivitet for året, årets forskydning i likvider samt selskabets likvider ved årets begyndelse og slutning.

RESULTATOPGØRELSE OG BALANCE

RESULTATOPGØRELSE (tkr.)

Noter		2009	2008
	Kundeomsætning	2 504	3 023
	Projektomsætning	2 249	2 221
	Resultatkontrakt	13 356	11 560
	Nettoomsætning i alt	**18 109**	**16 804**
	Projektpartnere	234	228
	Rejseomkostninger	461	478
	Andre udlæg	649	1 136
	Udlæg i alt	**1 344**	**1 842**
1	**Bruttoresultat**	**16 765**	**14 962**
2	Personaleomkostninger	12 254	10 703
	Andre eksterne omkostninger	3 820	2 847
	Omkostninger i alt	**16 074**	**13 550**
	Resultat før afskrivninger	**691**	**1 412**
3	Af- og nedskrivninger af materielle anlægsaktiver	1 250	1 190
	Resultat før finansielle poster	**(560)**	**222**
	Finansielle indtægter	218	307
	Finansielle omkostninger	7	5
	Resultat før skat	**(349)**	**524**
	Skat af årets resultat	0	0
	Årets resultat	**(349)**	**524**
	Årets resultat overføres til næste år.		

BALANCE PR. 31 DECEMBER (tkr.)

Noter	AKTIVER	2009	2008
	Deposita	372	372
	Finansielle anlægsaktiver i alt	**372**	**372**
	Udstyr og inventar	3 784	3 510
	Indretning af lejede lokaler	2 341	2 643
3	**Materielle anlægsaktiver i alt**	**6 125**	**6 153**
	Anlægsaktiver i alt	**6 497**	**6 525**
4	**Igangværende arbejder for fremmed regning**	**1 143**	**1 414**
	Tilgodehavender fra salg og tjenesteydelser	895	1 985
	Andre tilgodehavender	107	54
	Tilgodehavender i alt	**1 002**	**2 039**
	Likvide midler	**7 576**	**6 589**
	Omsætningsaktiver i alt	**9 722**	**10 042**
	Aktiver i alt	**16 219**	**16 568**

	PASSIVER	2009	2008
	Aktiekapital	1 000	1 000
	Overført resultat	11 880	12 228
5	**Egenkapital i alt**	**12 880**	**13 228**
	Forudbetalinger fra kunder og bevillingsgivere	656	217
	Kreditorer og skyldige omkostninger	1 084	1 775
	Gæld til modervirksomhed	188	0
	Anden gæld	1 411	1 348
	Kortfristet gæld i alt	**3 339**	**3 339**
	Passiver i alt	**16 219**	**16 568**
6	Eventualforpligtelser		

PENGESTRØMSOPGØRELSE

PENGESTRØMSOPGØRELSE (tkr.)

Noter		2009	2008
	Periodens resultat før renter og afskrivninger	691	1 412
	Ændring i igangværende arbejder for fremmed regning	271	975
	Ændring i tilgodehavender fra salg og tjenesteydelser	1 090	(1 484)
	Ændringer i andre tilgodehavender og periodeafgrænsningsposter	(53)	131
	Ændring i kortfristede gældsforpligtelser	0	1 031
	Pengestrømme fra driften	**1 999**	**2 066**
3	Køb og salg af materielle anlægsaktiver	(1 222)	(547)
	Pengestrøm fra investeringsaktivitet	**(1 222)**	**(547)**
	Renteindtægter og -omkostninger	211	302
	Pengestrøm fra finansieringsaktivitet	**211**	**302**
	Periodens likviditetsforskydning	**988**	**1 821**
	Likvide beholdninger primo	6 588	4 767
	Likvide beholdninger ultimo	**7 576**	**6 588**

NOTER

1 **Efterkalkulerede egenfinansierede forsknings- og udviklingsomkostninger er opgjort til 613 tkr. (2008: 607 tkr.)**

2

Personaleomkostninger (tkr.)	**2009**	**2008**
Løn og gager	12 059	10 583
Pensioner	55	0
Andre omkostninger til social sikring	140	119
Personaleomkostninger i alt	**12 254**	**10 703**

DFM har i 2009 i gennemsnit beskæftiget 20 medarbejdere opgjort efter antal årsværk (2008: 18). Løn og gager indeholder vederlag til direktionen og bestyrelseshonorar.

3 **Materielle anlægsaktiver (tkr.)**

Anskaffelsessum	**Udstyr og Inventar**	**Indretning af lokaler**	**Arkivalier**	**I alt**
Saldo 2009-01-01	6 242	3 549	760	10 551
Tilgang	1 223	0	0	1 223
Afgang	26	0	0	26
Saldo 2009-12-31	7 439	3 549	760	11 748
Afskrivninger				
Saldo 2009-01-01	2 732	906	760	4 398
Afskrivninger	949	302	0	1 251
Afskrivninger, afhændede aktiver	26	0	0	26
Saldo 2009-12-31	3 655	1 208	760	5 623
Bogført værdi	**3 784**	**2 341**	**0**	**6 125**
Vinding ved køb/salg	1	0	0	1
Årets Afskrivning i alt	**948**	**302**	**0**	**1 250**

4

Igangværende arbejder for fremmed regning (tkr.)	**2009**	**2008**
Offentlige danske institutioner	602	397
Udenlandske institutioner	541	1 016
Danske virksomheder	0	0
Igangværende arbejder i alt	**1 143**	**1 414**

5

Egenkapital (tkr.)	**Aktiekapital**	**Overført resultat**	**I alt**
Egenkapital 2009-01-01	1 000	12 228	13 228
Årets resultat		(349)	(349)
Egenkapital i alt	**1 000**	**11 880**	**12 880**

Der er udstedt 1 000 000 aktier med pålydende værdi på 1 kr.

Ejerforhold
Følgende aktionær ejer hele aktiekapitalen:

Danmarks Tekniske Universitet
Anker Engelundsvej 1
Bygning 101A
2800 Kgs. Lyngby

6 **Eventualforpligtelser**

Selskabet har en lejeforpligtelse vedrørende lejemål med en opsigelsesperiode på op til 12 måneder, svarende til 839 tkr. (2008: 808 tkr.)

Participation in committees and working groups under the Metre Convention and EURAMET

+ Comité International des Poids et Mesures (CIPM)
+ EMRP Committee
+ Consultative Committee for Electricity and Magnetism (CCEM)
+ Consultative Committee for Amount of Substance (CCQM)
+ Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)
+ EURAMET Technical Committee for Mass (TC-M)
+ EURAMET Technical Committee for Electricity and Magnetism (TC-EM)
+ EURAMET Technical Committee for Length (TC-L)
+ EURAMET Technical Committee for Photometry and Radiometry (TC-PR)
+ EURAMET Technical Committee for Acoustics, Ultrasound and Vibration (TC-AUV)
+ EURAMET Technical Committee for Time and Frequency (TC-TF)
+ EURAMET Technical Committee for Interdisciplinary Metrology (TC-IM)
+ EURAMET Technical Committee for Quality (TC-Q)
+ BIPM Director's ad hoc Advisory Group on Uncertainty
+ Joint Committee on Guides in Metrology – Working Group 1, Guide to the expression of uncertainty in measurement (JCGM-WG1)
+ Consultative Committee for Length – Working Group on Dimensional Metrology – Discussion Group on Nano-metrology (CCL-WGDM-DG7)
+ Consultative Committee for Amount of Substance – Working Group on Electrochemical Analysis (CCQM – EAWG)
+ Consultative Committee for Mass and Related Quantities – Working Group on Changes to the SI kilogram (CCM-WGSI-kg)
+ Consultative Committee for Mass and Related Quantities – Working Group on Mass Standards – Task Group 2; Uncertainty components due to traceability to the international prototype of the kilogram (CCM-WGM-TG2)

Participation in national and international projects

+ Centre for industrial nano optics (CINO), RTI
+ Functional materials with embedded nano structures (FINST), RTI
+ Determination of the Boltzmann constant for the redefinition of the kelvin, EMRP/RTI
+ Breath analysis as a diagnostic tool for early disease detection, EMRP/RTI
+ Traceable measurements for biospecies and ion activity in clinical chemistry, EMRP/FI
+ Measurement of size and shape of aerosols, FI
+ Centre of excellence for acoustic metrology, FI
+ Improving measurement of electrical power quality, FI
+ Quantitative measurement of atmospheric molecules, FI
+ Printed holograms – Basic properties, RTI
+ Coordination of nanometrology in Europe (Co-Nanomet), EU

Calibration certificates and measurement reports

+ DC electricity	6
+ Electrochemistry	200
+ Mass	16
+ Length	10
+ Optical radiometry	20
+ Nano structures	4
+ Acoustics	7
+ Total	263

Publications 2009

+ N. Tabrizian, P.E. Hansen og H.N. Hansen
  Optical characterization of turned and anodized aluminium
  Proceedings of the euspen International Conference,
  San Sebastian, June 2009. ISBN 13: 978-0-9553082-6-0
  DFM-2009-P01

+ Salvador Barrera Figueroa,
  Knud Rasmussen and Finn Jakobsen
  Hybrid method for determining the parameters of condenser microphones from measured membrane velocities and numerical calculations, Journal of Acoustic Society of America 126 (2009) 1788-1795
  DFM-2009-P02

+ P.-E. Hansen and L. Nielsen
  Combined optimization and hybrid scalar-vector diffraction method for grating topographyparameters determination
  Materials Science & Engineering B 165 (2009) 165-168
  DFM-2009-P03

+ P. Morgen, B.O. Henriksen, D. Kyrping, T. Sørensen, Y.X. Yong, J. HolstJ.R. Aelsen and P.E. Hansen
  Examples of Current Industrial Micro- and Nanomaterials and Techniques for their Characterization
  Nanostructured Materials for Advanced Technological Applications, NATO Science for Peace and Security Series B: Physics and Biophysics, Volume. ISBN 978-1-4020-9915-1.
  Springer Netherlands, (2009), 103-113
  DFM-2009-P04

+ Steffen Seitz, Petra Spitzer,
Pia T. Jakobsen and Hans D. Jensen
Metrological Traceability Concept for
Electrolytic Conductivity and pH
CHIMIA 63 (2009) 640-642
DFM-2009-P05

DFM Reports 2009

+ DFM Årsrapport 2008
DFM-2009-R01

+ Poul Erik Hansen
ODM analyse af begravede strukturer
DFM-2009-R02

+ Kai Dirscherl
Euramet 1027 – Calibration particles measured
with an AFM
DFM-2009-R03

+ Kim Carneiro, Hans Dalsgaard Jensen, Preben Howarth
og Isabella Stendal.
Faglig rapportering til Rådet for Teknologi og Innovation
2008
DFM-2009-R04

+ Kim Carneiro, Gunnar Østergaard, Kaj Bryder og
Jørgen Duvald Christensen
Faglig rapport 2008: Styrket international deltagelse
og organisering af dansk metrologi
DFM 2009-R05

+ Kai Dirscherl
Metrologic validation of aerosol measurement methods
DFM-2009-R06

+ Salvador Barrera Figueroa
Dansk Primærlaboratorium for Akustik
Årsrapport 2008
DFM-2009-R07

+ Jan Hald, Lars Nielsen og Jan C. Petersen
An acetylene stabilised fibre laser
DFM-2009-R08

+ C.I. Falk, J. Hald, J.C. Petersen and K. Rotwitt
Enhanced nonlinear interactions in liquid-filled
photonic crystal fibres
DFM-2009-R09

+ Kim Carneiro, Salvador Barrera Figueroa,
Knud Rasmussen, Erling S. Olsen, Erling Frederiksen,
Torben Licht og Ole Esben Sørensen
Handlingsplan for metrologi inden for Akustik,
Ultralyd og Vibration
DFM-2009-R10

+ Salvador Barrera Figueroa og Erling Frederiksen
Measurement of the front cavity of laboratory
standard microphones
DFM-2009-R11

+ Michael Kjær, Hans D. Jensen og Jan C. Petersen
Strategiplan for perioden 2010-2012
Metrologi som grundlag for vækst
DFM-2009-R12

+ Kai Dirscherl
Comparison of an AFM method for the measurement
of nanoparticle diameter with NIST-traceable reference
material
DFM-2009-R13

+ Kim Carneiro, Enrico Canuto, Marco dell'Isola, Settimio
Mobilio Giuseppina Rinaudo and Alberto Dal Poz
Evaluation of Istituto Nazionale di Ricerca Metrologica 2008
Evaluation of INRIM 2008
DFM-2009-R14

+ Kim Carneiro
Finansieringen af metrologisk udstyr
DFM-2009-R15

+ Preben Howarth
AL 08 IB FI 05
Strengthening of the national metrology infrastructure
and achievement of international recognition.
Afsluttende rapport Tilskud til dansk deltagelse i EU's
twinning programmer (FINS)
DFM-2009-R16

+ Salvador Barrera-Figueroa, Lars Nielsen, Knud Rasmussen
Andrés E. Pérez Matzumoto and José Noé Razo Razo
Report on the Key Comparison CCAUV.A-K4 Draft B
DFM-2009-R17

+ Preben Howarth
Rapportering af formidling fra danske kontaktpersoner 2009
DFM-2009-R18

+ Kai Dirscherl, Jørgen Garnæs og Lars Nielsen
Interlaboratory comparisons 2007, Metrology –
Mass, final report
DFM-2009-F01

+ Kai Dirscherl, Jørgen Garnæs og Lars Nielsen
Interlaboratory comparisons 2007, Metrology –
Length, final report
DFM-2009-F02

+ Kai Dirscherl
Udmåling af en linsemaster
DFM-2009-F03

+ Jørgen Garnæs
Forundersøgelse af cylinderformede mikrolinser
støbt i plastik med atomic force mikroskopi
DFM-2009-F04

+ Hans D. Jensen og Pia Tønnes Jakobsen,
(Draft A) Report on CCQM P83 – measurement of
low conductivity
DFM-2009-F05

+ Kim Carneiro
Developing Metrology in Chemistry in Peru, with special
attention to drinking water
DFM-2009-F06

+ Jørgen Garnæs
Cemecon: Undersøgelse af prøver med belægning
DFM-2009-F07

+ Jørgen Garnæs
Investigation of NIL test samples
DFM-2009-F08

Reports in series F are confidential

Contribution at conferences and monographs

+ Vicente Cuitanda-Henriquez, Peter Møller Juhl, Salvador Barrera-Figueroa
Numerical design and testing of a sound source for secondary calibration of microphones using the Boundary Element Method
NAG/DAGA 2009, Rotterdam, The Netherlands, March 23-26, 2009.

+ J. Garnæs, K. Dirscherl, J. Hald, J. Henningsen, K. E. Johansson
Sub-nanometer accurate atomic force microscopy over 0.5 mm (Poster)
NanoDay 2009 – Joint meeting between Nano DTU, Nano-Science Center, NanoTUM and TU/e and Technical University of Denmark
Kgs. Lyngby, Denmark, May 6, 2009

+ Jan Hald, Lars Nielsen og Jan C. Petersen
A spectroscopic determination of the Boltzmann constant (Poster) CLEO/Europe-EQEC
Munich, Germany, June 15-19, 2009

+ Salvador Barrera-Figueroa, Marta Diaz-Ben, Finn Jacobsen
Pressure calibration of measurement microphones in a free field
Internoise 2009
Ottawa, Canada, August 2009.

+ Lars Nielsen, Jan Hald, Jan C. Petersen
Evaluation of the Boltzmann constant from Doppler broadened absorption spectra
IV International Workshop on Progress in Determining the Boltzmann Constant
Torino, Italy, September 22-24, 2009

Other talks

+ Jørgen Garnæs
Ultra precise nanometer scale measurements lecture in course 10030 Physics and Nanotechnology and practical exercise for two students (2009)
The Technical University of Denmark, January 8, 2009

+ Jan Hald, Kai Dirscherl
Kursus i validering af software til laboratoriebrug
DFM, 22-23 Januar 2009

+ Jørgen Garnæs
Gauge block calibration – Demonstration on primary optical techniques lecture in course 42215 – Geometrical metrology and machine testing
The Technical University of Denmark, April 15, 2009

+ Jan Hald, Kai Dirscherl
Kursus i validering af software til laboratoriebrug,
Statens Seruminstitut, 21-22 April 2009

+ Jan Hald, Jan C. Petersen, Lars Nielsen
Experimental progress, Boltzmann WP4 meeting
Caserta, Italy, April 28, 2009

+ Lars Nielsen, Jan Hald
The Boltzmann project – Evaluation of measurement data
Boltzmann WP4 meeting
Caserta, Italy, April 28, 2009

+ Jan Hald, Jørgen Garnæs, Lars Nielsen
Foredrag om metrologi samt rundvisning for elever fra Nærum Gymnasium
DFM, May 4, 2009

+ Lars Nielsen
Evaluation of key comparisons using the method of least squares, 2nd Meeting of ICAC-2009 steering committee
Praha, Czech Republic, May 11, 2009

+ Lars Nielsen
Kursus i måleusikkerhed og metodevalidering
DFM, June 3, 2009

+ Jan Hald
Anvendelse af lasere ved Dansk Fundamental Metrologi
Gæsteforelæsninger i kurset Anvendt laserfysik,
Aarhus Universitet, October 7, 2009

+ Lars Nielsen
Kursus i usikkerhedsberegning med DFM-GUM
DFM, October 21, 2009

+ Jørgen Garnæs
Newly developed Danish atomic force microscope show surfaces with atomic scale resolution
Talk for the e-group at The Danish Society of Engineers, IDA Ingeniørhuset
Copenhagen October 27, 2009

+ Jørgen Garnæs
Discover the nano cosmos
Talk at the meeting Nanotechnology in working clothes arranged by FORCE Technology and DFM
FORCE Technology Brøndby, November 11, 2009

+ Lars Nielsen
Kursus i avanceret usikkerhedsberegning
DFM, December 7-8, 2009.

The association DANIAmet was established on 6 November 2008 by the three member organisations DANIAmet-MI, DANIAmet-CLM and DANIAmet-CDFM. DANIAmet-MI was formerly known as DANIAmet. The association DANIAmet was established to increase the visibility and improve the coordination of Danish metrology, which include fundamental, applied and legal metrology.

The organisation chart for DANIAmet is seen on the next page.

www.DANIAmet.dk

DANIAmet-MI is member organisation for the Danish metrology institutes, the MIs. They include the National Metrology Institute, DFM, and six Danish Designated Institutes. All of these institutes are nationally designated to maintain and develop either a primary or a reference standard for one ore more measurands.

A focus of DANIAmet-MI is to ensure that all Danish MIs state their Calibration and Measurement Capabilities in appendix C of the Key Comparison Database under the Comité International des Poids et Mesures Mutual Recognition Agreement.

kcdb.bipm.org/

DANIAmet-MI works to ensure Danish participation in relevant international organisations and through its members to improve and maintain general competences in fundamental metrology of importance to Danish industry.

DANIAmet-MI acts as a common voice for fundamental metrology in Denmark towards the political system and for knowledge transfer among members and to the Danish society.

At present, one of the most important tasks for DANIAmet-MI is the coordination of the Danish participation in the European Metrology Research Programme, EMRP, established as an article 169 institution under the European Treaty as part of the seventh framework programme. The total budget of the EMRP is 400 M€ of which the Danish share is 2 235 k€.

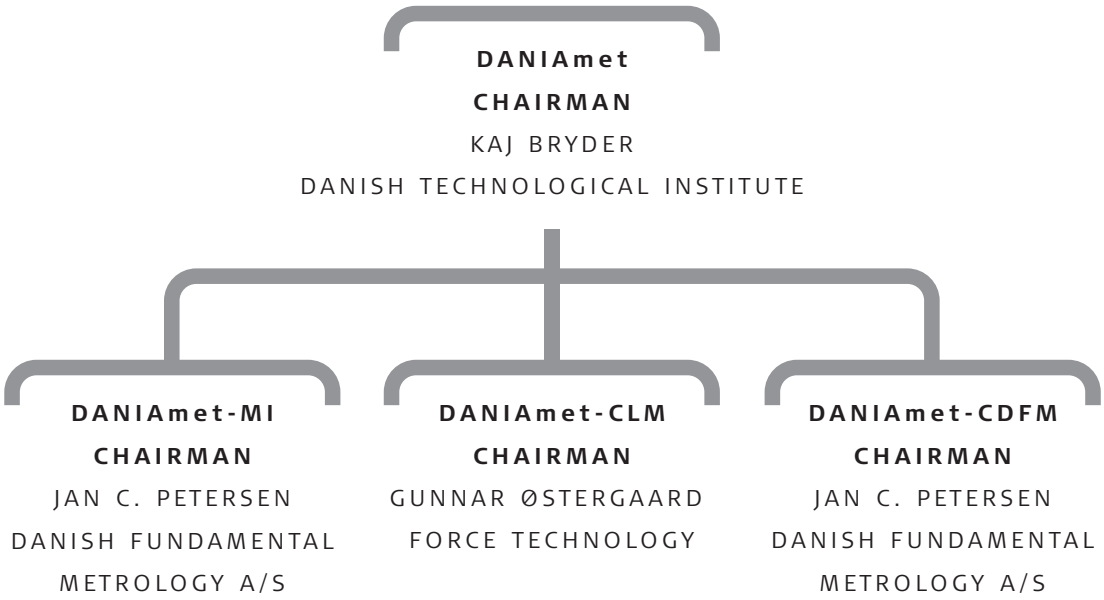
www.euramet.org/index.php?id=993

The Danish MIs are currently working mostly in physical measurands. However, efforts are made to inform laboratories within chemistry, health and environment about the advantages of metrology, with the aim to include these laboratories as members of DANIAmet-MI in a few years time.

FUNDAMENTAL METROLOGY

Fundamental metrology has no international definition, but it generally signifies the highest level of accuracy within a given field. Fundamental metrology may therefore be described as the top level branch of scientific metrology, which deals with the organisation and development of measurement standards and with their maintenance.

Organisational chart for DANIAmet



DANIAmet-CLM is member organisation for the Danish players within legal metrology.

DANIAmet-CDFM is member organisation for the Danish metrology institutes that are members of GTS – Advanced Technology Group.

www.teknologiportalen.dk/en

COLLABORATION ON PRIMARY LABORATORIES

Metrology is divided into subject fields. More than one Danish MI work within some of these fields.
A number of formalised co-operation agreements has been signed between the involved MIs.
The co-operation laboratories are (with the names of the participating MIs after the name of the laboratory):

DANISH PRIMARY LABORATORY FOR ACOUSTICS (DPLA):
Brüel & Kjær Sound & Vibration Measurement A/S and Danish Fundamental Metrology A/S

DANISH PRIMARY LABORATORY FOR ELECTRICITY (DPLE):
Danish Fundamental Metrology A/S and Trescal A/S

DANISH PRIMARY LABORATORY FOR LENGTH (DPLL):
Technical University of Denmark – DTU Mechanical Engineering, Danish Fundamental Metrology A/S and Danish Technological Institute

BKSV-DPLA
Brüel & Kjær Sound &
Vibration Measurement A/S
Skodsborgvej 307, DK-2850 Nærum, Denmark
Contact person for DANIAmet-MI: Torben Licht
Telephone: +45 7741 2313
trlicht@bksv.com

Danish Energy Association
Rosenørns Allé 9, DK-1970 Frederiksberg C, Denmark
Contact person for DANIAmet-CLM:
Hans Jørgen Jensen
Telephone: +45 3530 0772
hhj@danskenergi.dk

DELTA
DELTA Danish Electronics, Light & Acoustics
Venlighedsvej 4, DK-2970 Hørsholm, Denmark
Contact person DANIAmet-MI:
Anders Bonde Kentved
Telephone: +45 7219 4275
abk@delta.dk
Contact person for DANIAmet-CLM
and DANIAmet-CDFM:
Jørgen Duvald Christensen
Telephone: +45 7219 4217
jdc@delta.dk

DFM
Danish Fundamental Metrology A/S
Matematiktorvet 307,
DK-2800 Kgs. Lyngby, Denmark
Contact person for DANIAmet-MI and
DANIAmet-CDFM: Jan C. Petersen
Telephone: +45 4525 5864
jcp@dfm.dtu.dk

DTI
Danish Technological Institute
Kongsvang Allé 29, DK-8000 Århus C, Denmark
Contact person for DANIAmet-MI:
Jan Nielsen
Telephone: +45 7220 1236
jan.nielsen@teknologisk.dk
Contact person for DANIAmet-CLM and
DANIAmet-CDFM: Kaj Bryder
Telephone: +45 7220 1220
kaj.bryder@teknologisk.dk

DTU
Technical University of Denmark
Anker Engelundsvej 1, Bygning 101A,
DK 2800 Kgs. Lyngby, Denmark
Contact person for DANIAmet-MI:
Knut Conradsen
Telephone: +45 4525 1010
prorektor@adm.dtu.dk

FORCE
FORCE Technology
Navervej 1, 6600 Vejen, Denmark
Contact person for DANIAmet-MI,
DANIAmet-CLM and DANIAmet-CDFM:
Gunnar Østergaard
Telephone: +45 7696 1603
gho@force.dk

Trescal A/S
Mads Clausens Vej 12, DK-8600 Silkeborg
Contact person for DANIAmet-MI:
Torsten Lippert
Telephone: +45 8720 6969
torsten.lippert@trescal.com

A number of laboratories outside DANIAmet work for ministries and governmental agencies. The list below includes laboratories with a formal status as reference laboratory as well as laboratories doing similar work without a formal nomination.

DTU AQUA, Technical University of Denmark, National Institute of Aquatic Resources
Charlottenlund Slot, Jægersborg Allé 1,
2920 Charlottenlund
Ministry: Ministry of Science, Technology and Innovation
Field: Food Chemistry
Contactperson: Maike Timm Heinrich
Telephone: +45 3396 3300
www.dtu.dk

Faculty of Agricultural Sciences, Aarhus University, Department of Integrated Pest Management
Forsøgsvej 1, Flakkebjerg, 4200 Slagelse
Ministry: Ministry of Food, Agriculture and Fisheries
Field: Environmental Chemistry (soil and water)
Contactperson: Niels Henrik Spliid
Telephone: +45 8999 1900
Fax: +45 8999 3501
www.agrsci.dk

Danish Institute for Eksternal Quality Assurance for Laboratories in the Health Care, DEKS
Herlev Hospital, Herlev Ringvej 75, 2730 Herlev
Ministry: Ministry of Health and Prevention
Field: Laboratory Medicine
Contactperson: Inger Plum, 54M1
Telephone: +45 4488 3454
Fax: +45 4453 5369
www.deks.dk

Eurofins Danmark A/S
Strandesplanaden 110, 2665 Vallensbæk Strand
Ministry: Danish Ministry of the Environment
Field: Environmental Chemistry (water, soil, sludge and waste)
Contactperson: Ulla Lund
Telephone: +45 7022 4230
Fax +45 7022 4255
www.eurofins.dk

FORCE Technology – Division for Energy and Environment
Park Allé 345, 2605 Brøndby
Ministry: Danish Ministry of the Environment
Field: Air emission monitoring
Contactperson: Lars Gram
Telephone: +45 4326 7000
Fax: +45 4326 7011
www.force.dk

National Environmental Research Institute, Aarhus University, Department of Atmospheric Environment
Frederiksborgvej 399, 4000 Roskilde
Ministry: Danish Ministry of the Environment
Field: Ambient air pollution measurements
Contactperson: Lone Grundahl
Telephone: +45 4630 1134
Fax: +45 4630 1214
www.dmu.dk

National Environmental Research Institute, Aarhus University, Department of Environmental Chemistry and Environmental Microbiology
Frederiksborgvej 399, 4000 Roskilde
Ministry: Danish Ministry of the Environment
Field: Environmental Chemistry and Microbiology
Contactperson: Pia Lassen
Telephone: +45 4630 1200
Fax: +45 4630 1114
www.dmu.dk

DTU Food, National Food Institute, Technical University of Denmark
Mørkhøj Bygade 19, 2860 Søborg
Ministry: Ministry for Foods, Agriculture and Fisheries
Field: Food chemistry/food microbiology
Contactperson: Inge Meyland
Telephone: +45 3588 7000
Fax: +45 3588 7001
www.dtu.dk

Danish Medicines Agency, Medicines Control Division
Axel Heides Gade 1, 2300 København S
Ministry: Ministry of Health and Prevention
Field: Microbiology, biology, chemistry, radioactivity
Contactperson: Margit Handlos
Telephone: +45 4488 9720
Fax: +45 4488 9195
www.dkma.dk

Eurofins Miljø A/S
Ladelundvej 85, 6600 Vejen
Ministry: Danish Ministry of the Environment
Field: Environmental microbiology
Contactperson: Randi Terp
Telephone: +45 7022 4266
Fax: +45 7022 4255
www.eurofins.dk

Eurofins Steins Laboratorium A/S
Ladelundsvej 85, 6600 Vejen
Ministry: Danish Ministry of the Environment
Field: Microbiology
Contactperson: Inger Guldbæk
Telephone: +45 7022 4266
Fax: +45 7022 4255
www.eurofins.dk

Danish Plant Directorate
Skovbrynet 20, 2800 Kongens Lyngby
Ministry: Ministry for Food, Agriculture and Fisheries
Field: Food chemistry/Environmental chemistry
Contactperson: Ole P. Kristensen
Telephone: +45 4596 6603
Fax: +45 4596 6610
www.pdir.fvm.dk

Department of Forensic Medicine, University of Copenhagen
Frederik V's vej 11, 2100 København Ø
Ministry: Ministry of Science, Technology and Innovation
Field: Forensic genetics
Contactperson: Bo Thisted Simonsen
Telephone: +45 3532 6136
Fax: +45 3532 6270
www.sund.ku.dk

Department of Forensic Medicine, University of Copenhagen
Frederik V's vej 11, 2100 København Ø
Ministry: Ministry of Science, Technology and Innovation
Field: Forensic Chemistry
Contactperson: Kristian Linnet
Telephone: +45 3532 6100
Fax: +45 3532 6085
www.sund.ku.dk

Statens Seruminstitut
Artillerivej 5, 2300 København S
Ministry: Ministry of Health and Prevention
Field: Microbiology
Contactperson: Helle Bruhn-Rasmussen
Telephone: +45 3268 8103
Fax: +45 3268 8124
www.ssi.dk

DELTA
Venlighedsvej 4, 2970 Hørsholm
Ministry: Danish Ministry of the Environment
Field: Noise measurement
Contactperson: Torben Holm Pedersen
Telephone: +45 7219 4000
Fax: +45 7219 4001
www.referencelaboratoriet.dk

THE TWELVE SUBJECT FIELDS OF METROLOGY

In Denmark fundamental metrology is divided into 12 subject fields defined by EURAMET. A Danish contact person has been assigned to each of these fields. The subject fields are divided into a number of subfields that reflects the metrological activities in Denmark. For each subject field, action plans are regularly prepared. These plans motivate the nomination of Metrology Institutes within subject fields of particular importance to Denmark and suggest other metrological initiatives. The years of the action plans are stated in parentheses under the subject field.

Subject field	Contact person	Subfields	Metrology Institute
MASS & RELATED QUANTITIES (1989, 1997, 2008)	Lars Nielsen, DFM ln@dfm.dtu.dk	Mass measurement Force and pressure Volume and density	DFM FORCE FORCE
ELECTRICITY AND MAGNETISM (1989, 1994, 2002)	Hans Dalsgaard Jensen, DFM hdj@dfm.dtu.dk	DC electricity AC electricity HF electricity	DFM Trescal Trescal
LENGTH (1989, 1998, 2007)	Jørgen Garnæs, DFM jg@dfm.dtu.dk	Basic length measurement Dimensional metrology Micro/Nano	DFM DTU & DTI
TIME AND FREQUENCY (1992, 2000)	Jan Hald, DFM jha@dfm.dtu.dk	Time measurement Frequency	
THERMOMETRY (1992, 1999, 2007)	Jan Nielsen, DTI jan.Nielsen@teknologisk.dk	Temperature measurement by contact Non-contact temperature measurement Humidity	DTI DTU DELTA
IONISING RADIATION (1992, 2000)	Arne Miller, DTU armi@risoe.dtu.dk	Absorbed radiation dose – Industrial products Absorbed radiation dose – Medical products Radiation protection Radioactivity	DTU
PHOTOMETRY AND RADIOMETRY (1990, 1996, 2004)	Jan C. Petersen, DFM jcp@dfm.dtu.dk	Optical radiometry Photometry Colorimetry Optical fibres	DFM
FLOW (1990, 1999, 2007)	Gunnar Østergaard, FORCE gho@force.dk	Gaseous flow (volume) Water flow (volume, mass and energy) Flow of liquids other than water Anemometry	FORCE DTI FORCE
ACOUSTICS, ULTRASOUND AND VIBRATION (1992, 2000)	Salvador Barrera-Figueroa, DFM, sbf@dfm.dtu.dk	Acoustical measurements in gases Acoustical measurements in solids Acoustical measurements in liquids	DFM BKSV-DPLA
AMOUNT OF SUBSTANCE (1992, 1995, 2004)	Pia Tønnes Jakobsen, DFM ptj@dfm.dtu.dk	Environmental chemistry Laboratory medicine Products and materials Food chemistry Pharmaceutical chemistry Microbiology Electrochemistry	 DFM
INTERDISCIPLINARY METROLOGY	Kim Carneiro, DFM kc@dfm.dtu.dk	No subfields	
QUALITY	Jan Hald, DFM jha@dfm.dtu.dk	No subfields	

DETAILS OF PERSONNEL

Board of directors
Lars Barkler, CEO, Lithium Balance A/S
Knut Conradsen, Vicepresident, Technical University of Denmark (Vice Chairman)
René Logie Damkjer, Managing Director, Agrotech A/S, Institute for Agri Technology and Food Innovation
Steen Konradsen, Director (Chairman)
Søren Stjernqvist, President, Danish Technological Institute
Kai Dirscherl, MSc (EE), PhD, Staff scientist, DFM A/S
Jan C. Petersen, PhD, Staff Scientist, DFM A/S

Management
Kim Carneiro, director, MSc (EE), PhD (until May 31)
Michael Kjær, CEO, MSc (EE) (from June 15)

Accountants
KPMG Statsautoriseret Revisionspartnerselskab

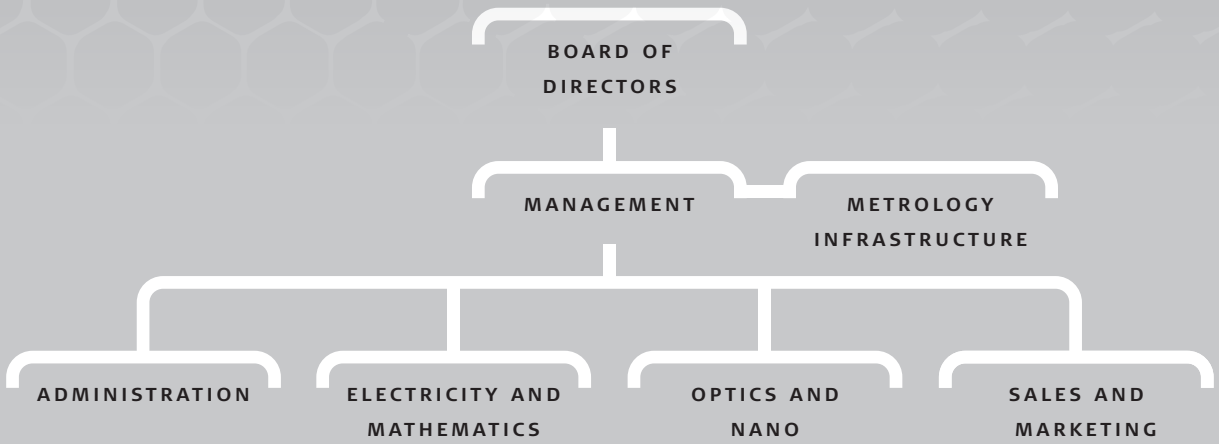
Staff
Kim Carneiro, MSc (EE), PhD
Lars Nielsen, MSc (EE), PhD
Steen Rahbek, Technician
Hans Dalsgaard Jensen, MSc (EE), PhD
Jan C. Petersen, PhD
Jørgen Garnæs, PhD
Preben Howarth, MSc (EE), BSc (economy)
Peter Høgh Hyllested, Technician
Jan Hald, PhD
Isabella Stendal, Administration
Bo Bengtsen, Technician
Salvador Barrera Figueroa, MSc (EE), PhD
Anne Lumholdt, Administration
Rita Pantoja Lesso, M.Sc. (until July 10)
Pia Tønnes Jakobsen, MSc (EE), PhD
Poul Erik Hansen, PhD
Kai Dirscherl, MSc (EE), PhD
Pia Krog-Pedersen, Administration
Charlotte I. Falk, MSc, PhD student
Zoraya Nieto-Florez, MSc (until July 10)
Guillermo Moreno Pescador (January 15 - December 31)
Niels Kjærgaard, PhD (from June 1)

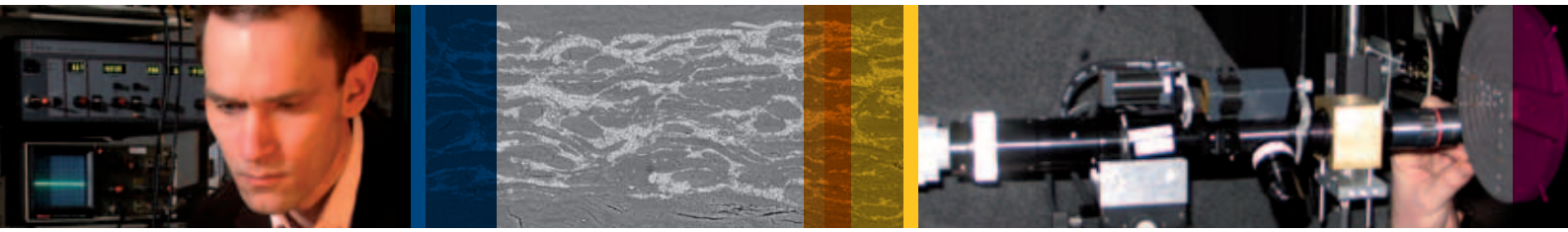
Visitors and students
Naia Tabrizian-Ghalehno, DTU Mechanical Engineering (until November 17)
Alessandro Godi, University of Padova (from August 24)
Javis Nwaboh, PTB (September 29 - October 10)

KEY FIGURES

Nøgletal i millioner kr.	2005	2006	2007	2008	2009
Bruttoomsætning	18,3	16,7	16,8	16,8	18,1
Nettoomsætning	15,0	14,9	15,0	15,0	16,8
Årets resultat[1]	0,6	0,3	0,2	0,5	-0,3
Egenkapital[2]	9,4	12,5	12,7	13,2	12,9
Kommerciel omsætning	5,2	2,8	3,9	3,0	2,5
- heraf små virksomheder (under 50 ansatte)	0,4	0,4	0,4	0,3	0,3
- heraf mellemstore virksomheder (50-250)	0,5	0,4	0,5	0,6	0,8
- heraf store virksomheder (over 250 ansatte)	0,2	0,2	0,4	0,5	0,4
- heraf offentlige danske institutioner	0,3	0,2	0,1	0,2	0,3
- heraf udenlandske virksomheder og institutioner	3,8	1,6	2,5	1,5	0,7
Udenlandsk bruttoomsætning	4,5	2,7	3,6	2,2	1,4
Forskning og Udvikling					
Antal samarbejdsprojekter	15	13	8	10	11
- heraf innovationskonsortier	1	1	2	2	2
- heraf internationale projekter	8	6	4	7	4
Forskning og udvikling omsætning (millioner kr.)[3]	13,6	15,4	13,6	14,3	15,4
- heraf egenfinansieret[4]	0,5	1,5	0,9	0,6	0,6
Forskning og udvikling indsats (årsværk)	8,7	10,8	8,3	9,4	10,6
Antal kunder					
Danske private virksomheder	27	22	39	51	44
- heraf små virksomheder (under 50 ansatte)	10	10	9	9	10
- heraf mellemstore virksomheder (50-250)	8	7	13	7	10
- heraf store virksomheder (over 250 ansatte)	9	5	17	17	15
Offentlige danske institutioner	3	3	4	8	9
Udenlandske virksomheder og institutioner	19	21	20	29	22
Samlet kundemasse	49	46	63	80	66
Antal medarbejdere efter uddannelse (årsværk)					
Dr. & ph.d.	10	10	10	10	9
M.sc.	3	3	3	3	5
Øvrigt teknisk personale	3	3	3	3	3
Administrativt personale	2	2	2	2	3
Gennemsnitligt antal medarbejdere	18	18	18	18	20
Antal publikationer					
Publikationer med bedømmelse	12	8	8	9	5
Afsluttede ph.d.- og eksamensprojekter	4	2	1	1	0
Andre rapporter	60	26	31	41	24
Indlæg ved konferencer	23	20	16	10	5
Kalibreringscertifikater og målerapporter	181	220	228	285	263
Presseklip	36	22	23	9	16
Undervisning					
DFM kurser (antal dage)	33	38	51	25	9
DFM kurser (antal deltagere)	161	201	215	135	26
Vejledere/undervisere på universiteter	3	4	2	3	2
Medvejleding/eksamensprojekter (antal) [5]				3	2
Bidrag til undervisning på universiteter (antal dage) [5]				5	5
Eksternt fagligt arbejde (antal udvalg)	31	25	21	27	30
- heraf internationalt fagligt arbejde	24	20	18	21	20
Effektivitet					
Omsætning pr. medarbejder (1.000 kr.)	1021	924	940	928	925
Overskud pr. medarbejder (1.000 kr.)	32	19	10	29	-18
Kommerciel omsætning pr. resultatkrone	0,6	0,3	0,4	0,3	0,2
FoU-omsætning pr. resultatkrone	0,5	0,7	0,5	1,2	1,2

1) Resultatet er eksklusive ekstraordinære poster
2) Til og med 2005 er tallene for den selvejende institution DFM, herefter for DFM A/S
3) Fra 2004 medtages også nationalt og internationalt samarbejde om metrologi
4) Fra 2005 er egenfinansieringen den efterkalkulerede egenfinansiering
5) Ny opdeling fra 2008


BOARD OF DIRECTORS
MANAGEMENT
METROLOGY INFRASTRUCTURE
ADMINISTRATION
ELECTRICITY AND MATHEMATICS
OPTICS AND NANO
SALES AND MARKETING



MISSION

To develop and disseminate measurement knowledge at an international scientific level with focus on Danish interests.