Skisser med relevans innenfor

Nanoteknologi og avanserte materialer

Tabell: Oversikt over skisser med relevans for området **Nanoteknologi og avanserte materialer**

Prosjekt-nummer	Prosjekttittel	Søkerinstitusjon	Prosjektleder	Estimert søkt beløp fra NFR
315742	Norwegian Centre for Nanoscale X-ray Tomography	NTNU (UiO, NTNU)	Ragnvald H. Mathiesen	33 250 000
316383	Acclerated Development of Metallic mAterials	SINTEF AS (NTNU)	Eivind Johannes Øvrelid	33 500 000
316409	Norwegian Nuclear Magnetic Resonance Platform 2	NTNU (UiO, UiB, UiT, SINTEF)	Olav Haraldseth	90 000 000
316413	Norwegian Fuel Cell and Hydrogen Centre - extension.	STIFTELSEN SINTEF (SINTEF, NTNU, IFE)	Magnus Skinlo Thomassen	51 000 000
316423	Competence Hub for Neutron Technology	IFE	Sindre P. Hassfjell	36 080 000
316428	The Norwegian X-ray Diffraction and Scattering Resource Centre (RECXII)	UiO (NTNU)	Helmer Fjellvåg	30 000 000
316435	The Goldschmidt Laboratory II: Advanced Characterization of Earth Materials	UiO (SINTEF, NGU)	Luca Menegon	54 110 000
316442	Norwegian Laboratory for Minerals and Materials Characterisation – II (MiMaC-II)	NTNU (SINTEF Industri, NGU)	Yanjun Li	48 300 000
316444	National Surface and Interface Characterisation Laboratory-NICE II	SINTEF AS (NTNU, UiO)	Spyros Diplas	43 200 000
316454	Powder technology: complete production chain from powder production through additive manufacturing to mechanical testing	UiA (Mechatronics Innovation Lab (MIL))	Geir Grasmo	136 900 000
316458	Norwegian open infrastructure for high-throughput experimentation and scale-up	UiB (NTNU)	Bengt Erik Haug	104 000 000
316463	Norwegian Micro- and Nanofabrication Facility IIIb	NTNU (UiO, USN, SINTEF)	Peter Köllensperger	32 000 000
316465	Center for Characterisation of Ultrasonic Devices	USN (TBD)	Lars Hoff	17 000 000
316476	NorHEMA - Norwegian facility for Helium ion & Electron Microscopy and microAnalyses	UiB (UiT, NORCE, DNV GL, Equinor, HI)	Ingunn Hindenes Thorseth	70 936 000
316504	National Platform for NanoSafety	UiB (NILU, STAMI, SINTEF Ocean, NMBU)	Mihaela Roxana Cimpan	111 600 000
316536	The Norwegian Nanocellulose Laboratory	RISE PFI AS	Kristin Syverud	26 000 000
316544	National research infrastructure for biopharmaceutical process development and production	SINTEF AS	Hanne Haslene-Hox	91 000 000

316552	Fiber & Steel ropes testing	NORCE (UiA, Mechatronics Innovation Lab (MIL))	Ellen Marie Nordgård-Hansen	35 000 000
316564	The Norwegian Centre for Transmission Electron Microscopy II	SINTEF AS (NTNU, SINTEF, UiO)	Randi Holmestad	141 000 000
316581	Enabling LHC Physics at Extreme Collision Rates II	UiO (UiB, HVL, USN)	Alexander L. Read	100 579 000
316594	Norwegian Advanced Battery Laboratory	IFE (UiO, FFI)	Hanne F. Andersen	60 800 000
316602	Norwegian Manufacturing Research Laboratory Phase 2	NTNU (SINTEF)	Kristian Martinsen	108 000 000
316610	NIBIO-XCT - An integrated X-ray Computed Tomgraphy (XCT) facility for the Ås campus (NIBIO/NMBU/Veterinærhøgskolen)	NIBIO (NMBU, Veterinærhøgskolen, Kimen Såvarelaboratoriet AS)	Adam Vivian-Smith	40 973 000

Project number: 315742
Title: Norwegian Centre for Nanoscale X-ray Tomography
Applicant (partners): NTNU (UiO, NTNU)
Project Manager: Ragnvald H. Mathiesen

Short summary:
X-ray imaging is a field in tremendous development, both at large-scale facilities and at university laboratories. In addition to the fundamental science aspects, X-ray imaging distinguishes itself by its applications in virtually all the natural and life sciences, and industry. X-ray imaging is consequently of utmost importance for Norwegian competitiveness, and there is a rapidly growing number of X-ray computed tomography (CT) instruments nationwide, both at the universities and in industry. In this landscape, there is a strong need for national coordination, also to ensure optimal use of the expensive infrastructure, alignment of investments and knowledge sharing. The NEXT consortium aims to fill this role, similarly to X-ray imaging centers abroad.

NEXT has hubs at UiO and NTNU, uniting the leading national research groups in X-ray imaging. NEXT will be coordinated by NTNU IFY, which is Norway's leading research unit in X-ray physics and imaging. The center has national and international affiliated collaborators, including several Centres of Excellence (CoE). In particular, the NTNU hubs are part of CoE PoreLab (www.porelab.no) and enjoy close collaboration also with CoI CASA (www.ntnu.edu/casa). NEXT will provide access to state-of-the-art X-ray imaging infrastructure for Norwegian users, both through upgrades of existing infrastructure and through established collaborations with imaging centers abroad. NEXT aims to maximize quality and cross-fertilization across disciplines, while maintaining a particular focus on porous media and mesoscopic structures.

The NEXT consortium has extensive X-ray imaging infrastructure, with complementary instruments covering life science, via environmental and geophysics, to material science. The labs are operated as open-access facilities with large and increasing external user demand. The proposed investments within X-ray CT and imaging are extensions to this existing infrastructure, planned to provide an optimal portfolio of methodologies in a united national perspective. Coordinating and strengthening the national X-ray imaging capability at mesoscopic scales is of huge importance to the climate, environment, energy, health and Norwegian industry.

NEXT will introduce and refine X-ray imaging techniques, such as phase-contrast based methods and time resolved studies, and actively support and educate users from a wide range of science disciplines through introductory courses, workshops, seminars and advanced training. NEXT will operate as a national competence center, ensuring that Norway stays abreast with the latest developments in X-ray imaging. The national competence center has as an aim to give Norwegian industry a competitive edge and aims to secure that the national X-ray imaging resources are exploited in the best possible way to maximize the advantage to society.

Project number: 316383
Title: Acclerated Development of Metallic mAterials
Applicant (partners): SINTEF AS (NTNU)
Project Manager: Eivind Johannes Øvrelid

Short summary:
The proposed infrastructure, ADMA, is aimed at developing a national centre for high throughput synthesis and characterization of materials to accelerate the development of advanced metallic materials in Norway. This infrastructure will be a complementary to, and closely collaborated with the existing national infrastructures, like MiMaC, NorTEM, NanoLab, NorFab and REXC.

This is going to be realised by investment of a series of advanced synthesis and characterisation equipment, which will be located in Trondheim shared between SINTEF and NTNU. The instruments are as follows:

- Gas atomization equipment for reactive materials with the possiblity to produce small quantities of powder
- Combined powder mixing and laser melting equipment: 5 different compartments with powders that each can portion 0.1g-10g of material, that can be mixed and filled into arrays of samples that fit into a ScanningElectronMicroscope
- Furnace for re-melting and annealing: To achieve equilibrium and investigate solid state processes
- Updating of characterization equipment:
    - The existing SEM instrument equipped will be upgraded to include Nano indentation system to test of mechanical properties of as-prepared alloys.
    - New software and hardware to allow for automation and high throughput data analysis.

Project number: 316409
Title: Norwegian Nuclear Magnetic Resonance Platform 2
Applicant (partners): NTNU (UiO, UiB, UiT, SINTEF)
Project Manager: Olav Haraldseth

Short summary:
The NNP-2 project's aims are to upgrade and expand the present Norwegian NMR platform (NNP - a national infrastructure on the RCN Roadmap) in order to maintain existing high-field capacity and quality and introduce new functionality. This will add new methods and possibilities for state-of-the-art applications of high-field NMR technology for Norwegian researchers and industry in a broad range of research fields of national importance.

More specifically NNP-2 aims to:

- Expand the geographical and thematic coverage through inclusion of new nodes
- Ensure continued and new state-of-the-art functionality of the existing NNP infrastructure through upgrades.
- Establish a national infrastructure for MR metabolomics as part of NNP-2
- Establish a national infrastructure for solid state NMR as part of NNP-2

To this end, NNP-2 will upgrade and expand the present NNP with the inclusion of the NMR labs at UiT, SINTEF in Oslo, and the MR Core Facility at the Faculty of Medicine and Health Sciences (MH) at

NTNU. The NNP-2 will thus have 6 nodes localized in Bergen, Tromsø, Trondheim (2 locations – NV Faculty and MH faculty) and Oslo (2 locations – UiO and SINTEF).

All these nodes have their own specific scientific and technological expertise, competence and experience. The 6 nodes are highly complementary and will offer the Norwegian research community a broad range of methods and services on a high international level of quality.

- Investments in NNP-2 will focus on maintaining the state-of-the-art level of the very-high-field (≥800MHz) instruments of the existing NNP through upgrades and includes important added functionality that will push the sensitivity limit and increase the spectral quality of liquid samples. These investments will benefit a broad range of Norwegian research communities of high national importance within medicine, chemistry, biotechnology, food sciences, toxicology, material science, energy, environment, and biology.
- The establishment of a national infrastructure for high-throughput MR metabolomics analysis of liquid and tissue samples will significantly benefit research in clinical medicine and population-based studies by facilitating discovery of disease mechanisms, new therapeutic targets and new methods for diagnosis and treatment follow-up.
- The establishment of a national infrastructure in solid state NMR enables for the first time in Norway highfield solid state NMR and will have great impact on research within material sciences and structure elucidation of proteins and systems in life science research.

Project number: 316413
Title: Norwegian Fuel Cell and Hydrogen Centre - extension
Applicant (partners): STIFTELSEN SINTEF (SINTEF, NTNU, IFE)
Project Manager: Magnus Skinlo Thomassen

Short summary:
The present proposal includes the extension of the already established Norwegian Fuel cell and hydrogen centre (NFCH) by adding two new nodes dealing with manufacturing infrastructure of fuel cell and electrolyser components and cells.

The NFCH is a national infrastructure that was established in 2017 and consists of three main nodes; i.e. a low temperature node, a high temperature node and a system node. This existing infrastructure involves three major Norwegian R&D stakeholders (SINTEF, IFE and NTNU), engaged in Fuel Cells and Hydrogen (FCH) technology development. Cutting-edge equipment for testing of fuel cell and electrolyser components, cells, and small stacks have generated widespread national and international interest.

During the establishment phase, as well as the first years of operation, the NFCH has already noticed the need for expanding present capabilities of the established nodes to accommodate a further increase in demand as well as introducing unique characterization techniques (inc. ex-situ and in-situ diagnostic equipment), essential for understanding and improving performance and longevity of fuel cells and electrolysers. In addition, there is a great need to strengthen the capability for Norwegian research institutions and industry for high quality research and innovation in the complete value chain of hydrogen technologies. Adding manufacturing capabilities of fuel cell and electrolyser components, stack assembly and infrastructure for utilization of liquid hydrogen will allow the centre and its users to provide capabilities that will be of great value in a number of projects, ranging from national and international researcher projects of fundamental and applied character to pilot projects for industry, and provide a breeding ground for innovation and spin-off activities.

Project number: 316423
Title: Competence Hub for Neutron Technology
Applicant (partners): IFE
Project Manager: Sindre P. Hassfjell

Short summary:
Institute for Energy Technology (IFE) has been running Norway's two nuclear research reactors for decades which are now shut down and scheduled for decommissioning. IFE and Norway have no longer a neutron source available, and it is of national importance to have a replacement. Otherwise, Norway will lose industrial possibilities and vital competence in nuclear technology, which is of importance for Norway's safety and security. As a first stage remedy, IFE intends to set-up a neutron facility at Kjeller, equipped with two types of neutron generators. One stationary D-T type generator for 14 MeV neutrons with high neutron flux output, and two mobile D-D or D-T type generator for 2.5 MeV neutrons with medium neutron flux output, along with detectors for neutrons and gamma-rays, both for analytical and safety measurements. This neutron facility can then produce radionuclides for medical applications, typically diagnostics and therapy of cancer, and industrial applications, typically mass flow studies and leak detection. Neutrons from neutron generators can be used for qualitative and quantitative analysis of light elements, which are otherwise difficult to measure, and for non-destructive radiography and tomography of various materials, e.g. in archaeology and art. The neutron irradiation facility will also be available for university studies in nuclear technology.

Project number: 316428
Title: The Norwegian X-ray Diffraction and Scattering Resource Centre (RECXII)
Applicant (partners): UiO (NTNU)
Project Manager: Helmer Fjellvåg

Short summary:
X-ray diffraction and scattering are essential tools for structural science, used in everything from batteries to biology. Recent developments in X-ray sources, detectors and optics are bringing experiments previously only possible at large-scale facilities like synchrotrons to the home laboratory. We will harness the latest instrumentation to bring new experimental capabilities to the highly successful Norwegian National Resource Centre for X-ray Diffraction and Scattering (RECX).

The investments proposed will also extend user base of the centre, making what is already a valuable resource for inorganic materials science, analytical chemistry, and soft matter in Norway more relevant for the life science and operando communities. The investments in Oslo will focus on two new instruments, a dedicated "BioSAXS" small angle scattering system and an operando specific powder X-ray diffractometer. Both machines will be equipped with the latest 2 D detector technology, high intensity X-ray sources and optics. To deliver maximum utility to the user community from the instrument platform we will invest heavily in sample preparation, process automation and sample environment equipment. This will create a lab where users from a range of disciplines can carry out very advanced experiments: examining the structure of working materials and devices, following biological processes in real time and studying samples available only in tiny volumes. The investments in Trondheim will also focus on two new instruments, where the first instrument will be dedicated to characterization of thin films and texture and strain in bulk materials, while the second instrument will focus on non-ambient X-ray diffraction under controlled atmosphere. Both instruments will be equipped with state-of-the-art detector technology, X-ray source and optics optimised for the purpose. The instruments will be configured to cover and promote expanding demand in the user community. RECX-II will, like RECX, act as a focus for X-ray based science in Norway. It will bring cutting-edge experiments from the large-scale facilities to a wider user base in the home laboratory, allow users to arrive well prepared for experiments at advanced large-scale facilities (in which Norway has already made significant investments), and act as a gathering point for the X-ray scattering and diffraction communities.

Project number: 316435
Title: The Goldschmidt Laboratory II: Advanced Characterization of Earth Materials
Applicant (partners): UiO (SINTEF, NGU)
Project Manager: Luca Menegon

Short summary:
In 1917, Victor Goldschmidt established 'Statens Råstofflaboratorium' at the MineralogicalGeological Museum, University of Oslo, which later was merged with the Geological Survey of Norway (NGU). It was funded directly from the Norwegian government to promote excellence in research with applications towards industrially important materials, notably the heat resistant mineral olivine. The Goldschmidt lab became a world leading research environment, made geochemistry a new science discipline, and Norway became the world's leading producer of olivine. Today, the University of Oslo hosts Scandinavia's strongest and most productive research environments within Solid Earth Geoscience with two Centers of Excellence (CEED and PGP), two ERC Advanced grants (Torsvik and Jamtveit) and two ERC startup grants since 2010. Earth and Environmental Sciences at UiO was recently ranked #3 in Europe outside UK in the 2020 Nature Index Tables. Still, research and research infrastructure directed towards Solid Earth Materials remain fragmented and poorly coordinated. Key analytical facilities are lacking or on the verge of being outdated.

In 2018, a new initiative was launched to establish a state-of-the-art infrastructure within geochemistry and material science in the spirit of 'Statens Råstofflaboratorium'. It was named The Goldschmidt Laboratory. In 2020, the Goldschmidt Laboratory received an initial 20 MNOK support from NFRs National Financing Initiative for Research Infrastructure based on the 2018 call. This funding will establish the geochronology part of the Goldschmidt Laboratory at the University of Oslo and the Geological Survey of Norway - a component hereafter referred to as Goldschmidt I. The current application, Goldschmidt II, is focused on establishing the main component of the Goldschmidt Laboratory: A modern high-tech laboratory directed towards micro and nano-scale studies of Earth materials and other solid materials of high research and industrial relevance in collaboration with Centre for Materials Science and Nanotechnology (Departments of Physics and Chemistry, UiO), SINTEF with its institute SINTEF-Industry, and the Faculty of Odontology (UiO). This component is essential for the further development of world leading, solid earth focused research at UiO, an imperative to keep pace with the leading high-tech environments in solid earth science in Europe, including ETH-Zürich and Utrecht University which precede UiO in the European ranking of

Earth and Environmental Sciences and which are well known for their worldleading infrastructures and laboratories.

Project number: 316442
Title: Norwegian Laboratory for Minerals and Materials Characterisation – II (MiMaC-II)
Applicant (partners): NTNU (SINTEF Industri, NGU)
Project Manager: Yanjun Li

Short summary:
The proposed infrastructure, MiMaC-II, is aimed at further development of a world-leading national laboratory for multiscale (atomic to micron) and multi-dimensional (from 1D to 3D) structure characterization and high-sensitivity (down to ppb level) chemical analysis of minerals, metals and advanced nanomaterials. This is going to be achieved by further upgrading and coordination of the existing laboratories of national infrastructure, MiMaC, funded by RCN. The consortium members of MiMaC II are the same as in MiMaC, NTNU, NGU and SINTEF. The partners have identified following state-of-the-art equipment either complimentary or supplementary to the instruments in MiMaC:

- Dedicated field emission gun scanning electron microscopy, FEG-SEM, for characterization of crystallography and chemistry of large solar cell Si-wafer samples
- Soft X ray Emission Spectrometer (SXES), used in SEM for detection of ultralight elements down to lithium, as well as atomic bonding in materials and minerals.
- Inductively Coupled Plasma Time-of-Flight – ICP TOF, for fast and full-spectrum element mapping with sensitivity down to ppb and ppt level.
- In-SEM Raman System, for characterization of band shift of minerals Up-grading of an existing focused ion beam (FIB) microscopy for preparation of special atom probe tomography (APT) samples
- AxioScan – automated scanning petrographic microscope, for automated characterization via machinelearning from thin section of geological materials
- Hyper spectral cathodoluminescence (CL) spectrometer, used in EPMA for high resolution trace element analysis.
- in-SEM µXRF – a specialized X-ray source to induce X-ray fluorescence of the specimen inside the SEM instrument, for in-situ low-level detection of heavy elements difficult to excitate by e-beam

Project number: 316444
Title: National Surface and Interface Characterisation Laboratory-NICE II
Applicant (partners): SINTEF AS (NTNU, UiO)
Project Manager: Spyros Diplas

Short summary:
NICE IIis an expansion of the infrastructure project NICE based on a collaboration between SINTEF, NTNU and UiO which established a national laboratory for physical and chemical characterization of surfaces and interfaceshaving the ambition to be acknowledged as a world class competence cluster. NICE was established in 2009 with the support of the RCN in two nodes, Oslo and Trondheim. NICE-II seeks to expand capabilities of the infrastructure and to enrich the national research capacity within the nationally prioritized application areas. We apply for funding to ensure access for the national

stakeholders to new, state-of-the-art surface analysis infrastructure enabling internationally leading research. The project aims to: (1) install the first Norwegian laboratory based XPS allowing for near ambient pressure (AP) analysis, and a modern multi-technique, user friendly UHV-XPS with high energy XPS capability, (2) integrate an XPS system into an operando STM allowing combined imaging and spectroscopy of surfaces in operando mode, (3) establish cutting-edge time-resolved APXPS experiments at MAXIV in conjunction with kinetic TAP experiments, (4) facilitate an integrated workflow among complementary instruments, (5) build competence, broaden national access, increase international networking and achieve data curation. These are expected to facilitate and secure a wide, open and effective use of the infrastructure within the research fields of catalysis, PV technology, H2 production, storage and transport, thermoelectric materials, Al alloys and processing, steels, Si, intermetallic and oxide powders etc. At the same time, it aims to solve industrial processing challenges via maintaining and advancing the surface science competence at high international standards. This will enable the national consortium and its end users to address current state-of-the-art research trends requiring rapid, real time, in situ, operando characterization to accelerate material development.

Project number: 316454
Title: Powder technology: complete production chain from powder production through additive manufacturing to mechanical testing
Applicant (partners): UiA (Mechatronics Innovation Lab (MIL))
Project Manager: Geir Grasmo

Short summary:
The roadmap for research infrastructure mentions need for research centres that can accommodate a complete value chain from basic fabrication of specific materials up to the production of prototypes. (s 34 https://www.forskningsradet.no/siteassets/publikasjoner/1254034464860.pdf) This project aims on developing such a research centre for metallurgical powder technology.

UiA and MIL are partners within the Future Materials Norwegian Catapult Centre, https://www.futurematerials.no/eng/about/. The Catapult Centres are established to accelerate the process from concept to market launch of the product, but they have broader scopes and focus on the implementation and application steps.

In this project we are aiming to upgrade the UiA research facilities in order to establish a national level research infrastructure for R&D and testing of the whole production chain from powder production to component prototypes of metallurgical materials. This will support the creation of a core, university-based research activity independent of the commercial interest involved in Future Materials, thus providing a platform for developing novel solutions and thus supporting the innovation both regionally and nationwide. The research infrastructure will be improved to a high enough level to facilitate seamless cooperation with the most advanced scientific research groups in Norway and abroad. The centre shall complement our existing catapult centre with more laboratory scaled R&D equipment.

Project number: 316458
Title: Norwegian open infrastructure for high-throughput experimentation and scale-up (NorHTE)
Applicant (partners): UiB (NTNU)
Project Manager: Bengt Erik Haug

Short summary:
This application seeks to establish a new national infrastructure platform (NorHTE) that will furnish Norway's research communities in chemistry, materials science, biotechnology, pharmaceuticals, and chemical and energy process engineering with state-of-the-art instrumentation for high-throughput experimentation (HTE) and advanced materials manufacturing. By offering a fast, automated and quality-assured alternative to error-prone manual methods, NorHTE will accelerate the discovery of new molecules and materials for multiple application areas, including electronics, catalysis, renewable feedstocks, therapeutics, diagnostics and energy generation and conversion.

The proposed infrastructure - the first of its kind in Norway - will comprise five integrated platforms for (i) high-throughput experimentation, (ii) flow-chemistry, (iii) real-time analysis, (iv) machine learning, and (v) scale-up. By combining automation, state-of-the-art robotics, chemometrics and machine learning, NorHTE will allow Norwegian scientists to carry out large-scale chemical experiments of far wider scope than is currently feasible, leading to superior products and/or more efficient synthesis routes. The main HTE platform will be located at UiB, with a complementary flow-chemistry platform located at NTNU. The Bergen node will consist of two robotic systems for aerobic and anaerobic synthesis, a system for automated purification, and analytical instrumentation for reaction monitoring and quality control. The Trondheim platform will comprise a suite of flow modules for in-line reaction, analysis, purification and scale-up. Both nodes will be furnished with extensive instrumentation for reaction monitoring, allowing for automated feedback-driven searches in which the most promising conditions for testing are decided on the basis of previously acquired data. The resulting "self-optimising" reactors will massively enhance the efficacy of HTE chemistry, bringing Norway to the international forefront of automated chemical discovery.

NorHTE will be open to both academic and industry users across Norway, with users being charged on an hourly rate model. The distinguishing feature of NorHTE which sets it apart from other HTE facilities worldwide is the inclusion of infrastructure for intermediate-scale chemical synthesis up to the 1-kg/day-level, providing users with a complete solution that encompasses both chemical discovery and chemical manufacturing.

Project number: 316463
Title: Norwegian Micro- and Nanofabrication Facility IIIb
Applicant (partners): NTNU (UiO, USN, SINTEF)
Project Manager: Peter Köllensperger

Short summary:
The NorFab III proposal submitted in 2018 sought 186 MNOK for a five-year period of funding from 2020-2024, continuing the ambitious development track we have been on so far. As per the NFRs request, a minimal version was also submitted, consisting of four years of operational support and just two years of investment funding, and this is the version NFR has funded. The minimal version represents the maintenance of current capabilities, with a few reinvestments to upgrade to state-of-the art. In order to maintain the infrastructure as a state-of the art national facility and replace

critical aging equipment, we are now applying for funding for the two remaining years of NorFab III, 2022-2023, as indicated during the NorFab III contract negotiations. The investment plan requires 32 MNOK in order to keep our current capabilities updated. NTNUs main investment will be the replacement of an aging Focused Ion Beam system that is at the end of its life cycle. This represents one of the most heavily used pieces of equipment at NTNU NanoLab. Several groups, including national infrastructures such as NorTEM and the MiMaC 3D Atom Probe Tomography system recently installed at NTNU are fully dependent on our FIB systems in order to operate. UiO MiNaLabs investments will be focused on replacing two aging instruments, namely a Scanning Probe Microscope and a Hall-effect instrument. These instruments are key to characterize thin films produced in the cleanroom and essential part of the thin-film production line. Furthermore, they ensure continued ability of localized (nm-scale) topographical and electrical characterization. Both current instruments have a large and increasing user base, and with the larger sample out-put obtained by the installed beyond-state-of-the-art cluster system, the more frequent need for maintenance creates critical bottlenecks in the infrastructure. USN MST lab in Horten planned with the original ambitious budget to invest in a SOA AlN deposition tool along with several upgrades of older tools. With the current minimum budget option, USN will upgrade the Wafer level bonder for 150mm wafers, Ultrasonic welder, Interferometer and Profilometer. SINTEF MiNaLab will focus its investment on a tool opening for new opportunities and offering new capabilities to our "tool box". We plan to invest in a submicron fine line lithography tool to bridge the gap between standard lithography with micron-resolution and nanolithography with <100 nm resolution. It is anticipated that such a tool will have an impact on all our research areas (radiation sensors, piezoMEMS, BioMEMS and Optical MEMS).

Project number: 316465
Title: Center for Characterisation of Ultrasonic Devices
Applicant (partners): USN (TBD)
Project Manager: Lars Hoff

Short summary:
The aim of this infrastructure is to strengthen Norway's position within research and development of advanced piezoelectric and ultrasonic devices. Norway has world-leading research groups within physical acoustics and ultrasound technology, supporting a high-tech industry making products based on this technology. The infrastructure we apply for is associated with the NFR appointed SFI Centre for Innovative Ultrasound Solutions (CIUS) and it is complementary to and will benefit from the infrastructure project Norwegian Infrastructure for Micro- and Nanofabrication (NorFab). The need for this infrastructure is acknowledged in the latest version of Norsk veikart for forskningsinfrastruktur (published 28 April 2020), where ultrasound technology and piezoelectric materials are identified as areas for new investments. The new infrastructure will give access to reliable and accurate electro-acoustic data for materials used in ultrasonic devices by establishing documented and well-maintained measurement systems and procedures. Such data are essential when developing and optimizing novel devices. The infrastructure also provides characterisation methods for research into novel materials and material structures, such as composite structures, acoustic meta-materials, and lead-free piezoceramics. Such materials will be central in developing next-generation ultrasound devices. The use of this infrastructure is not limited to ultrasound

transducer development, as it will be of use in research into other types of piezoelectric sensor and actuators devices and in research on RF filters based on ultrasonic waves, e.g. SAW and FBAR.

The infrastructure will improve research quality by providing accurate and reliable data for design and optimisation of novel ultrasonic devices. It will free up time for researchers allowing them to concentrate on the core of their research, and it will allow companies to design and fabricate more optimal devices in shorter time, reducing costly trial-and-error iterations. Access to such methods will make us an even more attractive partner in international research programs.

A variety of ultrasound measurement equipment has been built in Norwegian research institutions over the years. These were often developed ad-hoc for a specific task and are poorly documented and maintained. In the time leading up to submitting the final application, we seek to identify existing equipment at other institutions. We invite other research groups with similar needs and interests to take contact so we can coordinate our efforts.

Project number: 316476
Title: NorHEMA - Norwegian facility for Helium ion & Electron Microscopy and microAnalyses
Applicant (partners): UiB (UiT, NORCE, DNV GL, Equinor, HI)
Project Manager: Ingunn Hindenes Thorseth

Short summary:
NorHEMA will provide the latest and most advanced infrastructure technology for cutting-edge research in material- and life-science on ultrastructure, function and composition of a wide range of natural and synthetic materials, cells and tissues. The facility is highly relevant for many disciplinary and interdisciplinary fields including basic and applied biological science, geoscience, geobiology, nanophysics and nanotechnology, and also medicine and food research.

Helium Ion Microscopy (HIM), which will be unique in Norway, will provide sub-nanoscale imaging of non-conducting materials and life-science samples without coating, highly improved topological contrast of surface structures with high depth of field, and specialised nanoscale fabrication (particularly suitable for free standing and very small features structures). Furthermore, the addition of Secondary Ion Mass Spectrometry (SIMS) system to the HIM will allow detection of all elements/isotopes at unmatched sensitivity and spatial resolution in the investigated material. A Focused Ion Beam Scanning Electron Microscope (FIB-SEM) equipped with electron backscatter diffraction (EBSD) and energy dispersive spectroscopy (EDS) systems will allow high-resolution 3D imaging of material- and life-science samples and in-situ micro-analyses of crystallography and chemical composition. One Field Emission Scanning Electron Microscope (FE-SEM) will be equipped with a broad set of microanalytical tools, some of which are not yet available in Norway. In addition to EDS this will include wavelength dispersive spectroscopy (WDS) and micro-X-ray fluorescence (μ-XRF) spectroscopy for major and trace element analyses, cathodoluminescence (CL) for crystal growth fabric imaging, and RAMAN spectroscopy for crystallographic/phase analyses. Another FE-SEM will be equipped for serial block face SEM (SBEM), transmission SEM (tSEM) and array tomography (AT) for 3D imaging of large life- and material-science samples and correlative light and electron microscopy (CLEM). State of the art equipment will be provided for sample fixation and processing. An automated epi-fluorescence microscope, data storage and image processing resources will accomplish the toolkit for correlative microscopy.

Project number: 316504
Title: National Platform for NanoSafety
Applicant (partners): UiB (NILU, STAMI, SINTEF Ocean, NMBU)
Project Manager: Mihaela Roxana Cimpan

Short summary:
Nanotechnology is one of the six Key Enabling Technologies, which are expected to address many societal challenges by providing new and innovative solutions. The aim of the National Platform for NanoSafety (NPNS) is to provide relevant stakeholders, e.g., industry, academia, research centres and institutions, and consumers with easy access to the expertise, state of the art instrumentation, infrastructure and methods to assess the exposure, hazards and risks associated with nanomaterials (NMs). It will provide a national hub for expanding insight into the impacts of NMs on humans and the environment, support the development of safe(r) NMs, facilitate application of nanosafety principles to products and industrial processes and inform regulatory decisionmaking bodies to ensure responsible research and innovation in nanotechnology. The platform will cover evaluation of the physico-chemical characteristics and biological effects of various types of NMs, from metal oxides to organics, including polymer-based 'nanoplastic' and complex composite nanostructures. We will especially address the real and urgent need for biological three-dimensional models and interference-free methods that mimic real-life exposure to NMs. There will be an emphasis on high-throughput testing. The NPNS addresses the international goal of ensuring that NMs are in compliance with the proposed principle of small, smart and safe (the 3 S´s). The NPNS builds upon the SafeNano Norway Network and successful collaborations between Norwegian research centres in previous and current national and European projects focused on the safety assessment of NMs. The NPNS is strategically anchored in the prioritized research areas of the Research Council of Norway and of the host institutions, it will strengthen and expand the existing national and local networks and promote collaboration in the field.

Project number: 316536
Title: The Norwegian Nanocellulose Laboratory
Applicant (partners): RISE PFI AS
Project Manager: Kristin Syverud

Short summary:
Nanocelluloses are isolated cellulosic fibres or crystals with dimensions in the nanometer range. This group of cellulosic materials has gained a lot of interests during the last 15 years because of the potential beneficial use in many applications. Norway is one of the countries being in the forefront regarding research and industrialization. Although some types of nanocelluloses are industrially produced, this field of science is still immature. Hence, many breakthroughs regarding utilization are foreseen. Nanocellulose is expected to play a significant role in the transition to more biobased products.

The Norwegian nanocellulose laboratory (NORCELlab) will (1) provide internationally leading laboratory facilities to secure that Norwegian nanocellulose research stays in the international forefront and (2) facilitate realization of the high commercial potential in utilization of cellulose-based nanomaterials. Our vision is that the NORCELlab shall be the fundament for developing new, and further improve and upscale existing processes for production of nanocellulose and nanocellulose derivatives, as well as developing novel applications of nanocellulose in a wide range of fields, for production and commercialization in Norway. The main goal is that NORCELlab shall be a national infrastructure for nanocellulose research, accessible to national and international stakeholders, for the development of processes for sustainable production of nanocellulose and nanocellulose derivatives, and applications thereof.

The laboratory will comprise three categories of infrastructure: i) production and processing of nanocelluloses, ii) production of nanocellulose-based materials and structures and iii) characterization of nanocellulose and structures made thereof. NORCELlab will comprise highly sophisticated and specialized equipment within these three categories.

Project number: 316544
Title: National research infrastructure for biopharmaceutical process development and production
Applicant (partners): SINTEF AS
Project Manager: Hanne Haslene-Hox

Short summary:
Biopharmaceutical production includes the expression of both small compounds (e.g. antibiotics) and large proteins (e.g. antibodies) in microorganisms or mammalian cell culture systems. Large research efforts are today put into the discovery and development of new biopharmaceutical drugs to answer clinical needs and for better treatment of disease. However, for these drugs to reach the clinic, they must be produced at large scale in demanding regulatory landscape, where individual tailoring of processes are required for different expression systems and products. This is not trivial for academia or SMEs, and specialized equipment and competence is required to do the research needed to gain better understanding of the bioprocess underlying such products and enable efficient process development towards commercial manufacturing. The national research infrastructure for biopharmaceutical process development and production (BioPoD) will provide facilities and expertise to enable researcher-driven bioprocess research and development across the whole range of biopharmaceutical products. The infrastructure will cover 1) preproduction, 2) upstream and 3) downstream processing, 4) process monitoring and 5) postproduction, filling the gap between drug discovery and development and commercial manufacturing. BioPoD will build 30 years of expertise on and advance existing national leading infrastructure for cultivation, fermentation and high-throughput screening for biopharmaceutical research and development. The complementation of the existing infrastructure will enable continued collaboration with research environments, public sector, start-ups and established industry in Norway, and supplement the possibilities for early process development for novel drug products. BioPoD will also answer needs in developing production for personalized medicine and provide a basis for commercial and contingency production of national biopharmaceutical products in Norway.

Project number: 316552
Title: Fiber & Steel ropes testing
Applicant (partners): NORCE (UiA, Mechatronics Innovation Lab (MIL))
Project Manager: Ellen Marie Nordgård-Hansen

Short summary:
Currently, there is a trend for replacing traditional steel wire ropes with light-weight fiber ropes in several industries important for Norway, such as offshore oil and gas (lifting and mooring), deep sea mining (hoisting), and offshore wind power (mooring). NORCE and UiA have over the last years

focused strongly on industrial research for condition monitoring and condition-based maintenance. To establish reliable discard criteria and make good predictions about incipient failures and remaining useful life, measurements are combined with verifiable mathematical models for fault development. For modern materials like synthetic fiber ropes, a large knowledge gap exists, compared to the decades of test results and verified theories available for metal fatigue. The present proposal will focus on closing this gap using a systematic approach for the load cycle testing, combined with modern sensor technology and analytical methods. Establishing science-based discard criteria will benefit both the manufacturers and the end users, improving new designs and saving money while still operating within safe operational limits.

We therefore propose to extend the existing rope testing infrastructure in Agder with the world's most advanced kind of rope test fatigue machine. Most rope testing facilities, in Norway as well as abroad, perform fatigue testing until destruction, and may thereafter perform a repetition of the experiment using a reduced number of cycles and then inspect the rope visually or break the rope in a tension test. This is a slow and uncertain method, since the test must be repeated, each time performed with a different specimen.

Our idea is to establish an integrated rope testing assembly comprising: 1) a large machine for fatigue bending tests, where the rope goes over five sheaves in succession. 2) the machine will be instrumented with a range of technologies to collect different information during the test process related to load cycles, tension, elongation, temperature, and thermal & RGB images. 3) the assembly will be complimented with a High Processing unit for: a) deploying real-time data management tools (i.e. storage, access, categorization) and, b) hosting real-time analytics tools (e.g. analysis models based on physical properties, multivariate analysis of the visual and thermal images1,, computer vision for condition monitoring2, AI models for life-time prediction).

Project number: 316564
Title: The Norwegian Centre for Transmission Electron Microscopy II
Applicant (partners): SINTEF AS (NTNU, SINTEF, UiO)
Project Manager: Randi Holmestad

Short summary:
The Norwegian Centre for Transmission Electron Microscopy (NORTEM) is a large-scale, national infrastructure organized by NTNU, UiO and SINTEF serving academia and industry with high level research in terms of education, use, and research project deliverables. The first NORTEM project, granted by RCN in 2011, opened new laboratories in two nodes (Oslo and Trondheim) in the second half of 2013. The establishing phase of NORTEM ended in 2016 when a world class TEM Centre offering access to a range of TEM techniques had been realized. Since then we become a successful, highly used and internationally recognized national infrastructure.

The NORTEM vision is to have 'A world-class TEM Centre providing access to expertise and state-of-the-art infrastructure for fundamental and applied research within the physical sciences in Norway'.

Since the investments became operative in 2013, there have been substantial technological developments within TEM and the needs of the Norwegian research environments have evolved. In addition, NORTEM has gained experience on how to run a national large-scale facility with this complexity and broad spectrum of applications. To fulfill the vision and needs of NORTEM, new investments are required. This outline describes the needs and the plans for the NORTEM II period from 2022 to 2026. The new investments will make Norway internationally competitive by offering new state-of-the-art detector technology to the Norwegian research environment, following the new developments in TEM on in-operando, multidimensional data acquisition, and in particular offer new possibilities in studies of advanced functional materials. With the new investments NORTEM will be able to give access to a unique national and world-class TEM infrastructure with state-of– the-art facilities and expertise.

Project number: 316581
Title: Enabling LHC Physics at Extreme Collision Rates II
Applicant (partners): UiO (UiB, HVL, USN)
Project Manager: Alexander L. Read

Short summary:
The Large Hadron Collider (LHC) at CERN is one of the most successful international scientific infrastructures in the world, in particular famous for the discovery of the Higgs boson. In the years to come LHC will be upgraded to enable more advance physics searches and hopefully discoveries. The new High-Luminosity LHC aim to start operation in 2027. The upgraded intensity leads to 2-10 times higher collision rates delivered to the experiments as well as higher radiation doses. Norway is member of ATLAS and ALICE, two experiments that both will need to enhance their detectors, trigger systems, and computing systems accordingly. The first part (step 1) of the ALICE and ATLAS upgrades, NorLHC, have been funded by the RCN infrastructure program for the period 2018-2022. We hereby apply for the funds for the second period 2022-2027 NorLHCII (step 2), which will allow us to complete the hardware upgrade of the LHC experiments ALICE and ATLAS and maintain and prepare and upgrade the e-infrastructure for the experiments in the same period. HL-LHC is part of the ESFRI roadmap.

The ALICE and ATLAS experiments at the LHC provide an internationally unique infrastructure to conduct research in high-energy physics, in which over 200 Norwegian scientist, engineers, PhD and Master students participate in the HENP and HEPP projects. For ALICE most of the NorLHC upgrade, comprised mainly of new readout electronics for the TPC and ITS sub-detectors, will be completed by spring of 2021. For NorLHCII the three innermost layers of the ITS will be replaced by super-thin wafer-size MAPS sensors, and a new forward calorimeter - FoCal - will be added in time for the high-luminosity running to start in 2027. For ATLAS, the upgrades are for HL-LHC and our contributions to the Inner Tracker. Funds from NorLHC have been used to build up laboratory facilities to enable us to build around 200 novel silicon pixel modules and test them. Funds from NorLHC-II will be necessary to cover the period of module construction and commissioning both hardware and personnel. After 5 years of operation, a significant part of the NorLHC e-infrastructure will need replacing and an upgrade in order to manage the 3-5 times higher luminosity starting in 2027. The einfrastructure is distributed globally, with the Norwegian contribution located at the Universities of Bergen and Oslo.

Project number: 316594
Title: Norwegian Advanced Battery Laboratory
Applicant (partners): IFE (UiO, FFI)
Project Manager: Hanne F. Andersen

Short summary:
The Norwegian Advanced Battery Laboratory (NABLA) aims to link the research infrastructure to emerging industrial initiatives by providing the Norwegian research community with the state-of-the-art research tools essential for battery research and development. NABLA will enable creation of new future-oriented solutions necessary for the transition to the society powered by the renewable energy and will allow to position Norwegian research internationally. The foundation for NABLA is in the development of more efficient Li-ion batteries while providing the necessary infrastructure for the development of the next generation of batteries. The infrastructure is a collaboration effort between institutions that already have a large research portfolio within the field of battery technology and the Mobility Zero Emission Energy Systems (MoZEES) research centre. The participants have a long history of collaboration with the Norwegian companies ranging from material producers (e.g. Elkem and Cenate), to emerging battery cell producers (e.g. FREYR and Beyonder), battery system developers (Corvus and ZEM) and end users (e.g. Equinor and ABB). NABLA will be organized as a virtual laboratory accessible to all users. The infrastructure will also ensure internationally recognized research and will also focus on reproducibility, easy access, international attractiveness and will promote open research and collaboration.
The battery technology is an area where there is a strong demand for technology development at different levels. Therefore, the proposed infrastructure will meet variety of needs for users originating from research and business. The infrastructure will also play an important role in recruiting and training new scientists and engineers to the field. Overall, NABLA will enable expertise and technology to deliver the zero-emission transport on land and at sea. This is an area of strong growth industrially and will have a major impact on reducing greenhouse gas emissions in the nearest future. Furthermore, the advanced and emerging battery technologies will greatly contribute to the stationary energy storage technologies – another rapidly growing area. The infrastructure will therefore have a great commercial and societal significance.

Project number: 316602
Title: Norwegian Manufacturing Research Laboratory Phase 2
Applicant (partners): NTNU (SINTEF)
Project Manager: Kristian Martinsen

Short summary:
Norwegian Manufacturing Research Laboratory (project #269898) MANULAB is a national infrastructure for manufacturing research. MANULAB aims at creating an infrastructure capable of performing cutting edge research with state-of-the art equipment, and to support the Norwegian manufacturing industry to increase its global competitiveness and sustainability. Partners are; Norwegian University of Science and Technology (NTNU), SINTEF Industry and SINTEF Manufacturing AS. NTNU is project coordinator and professor dr.ing. Kristian Martinsen is the project manager. MANULAB is currently funded by 78 MNOK from the Norwegian Research Council. This draft proposal is for the second phase of MANULAB, based on the original MANULAB proposal, although there are updates from the original proposal given changes in the needs and the research state-of-the art. We

claim this equipment is necessary to achieve the complete MANULAB concept as described in the original proposal. With three partners and four geographical nodes the current phase 1 might be under critical mass. The phase 2 equipment will complement the phase 1 equipment in the following laboratory nodes; The Wireless sensor systems lab, the Additive Manufacturing (AM) lab, the Industry 4.0 lab, NAPIC one-piece flow aluminium forming line, IDEALAB for product and process development, Laser robotic welding lab, AMT SLM and The Gleeble thermomechanical testing machine. In addition, there will four new laboratory nodes; The polymer lab, the Nano AM lab, the Nano CT lab and the ceramics AM laboratory. These four new sub-laboratories mean that MANULAB will widen the scope to a fully multimaterial national research infrastructure, where metals, polymers and ceramics are included. Furthermore, MANULAB phase 2 will introduce nanoscale manufacturing with the nano-AM laboratory and the nanoscale Computed Tomography X-ray laboratory (CT).

Project number: 316610
Title: NIBIO-XCT - An integrated X-ray Computed Tomgraphy (XCT) facility for the Ås campus
Applicant (partners): NIBIO (NMBU, Veterinærhøgskolen, Kimen Såvarelaboratoriet AS)
Project Manager: Adam Vivian-Smith

Short summary:
Nano- and micro-scale X-ray Computed Tomography (XCT) has become an exceptionally important tool for the non-invasive visualization of complex specimens in both materials science and in biology. This offers a non-destructive method to probe both living and fixed material from a variety of sources and resolve their internal structures, often in stunning detail, resolution and depth (ie. to micrometer and sub-micrometer scale). Examples include (1) visualizing soil porosity and measuring the fine root structure, (2) imaging modifications to woody tissues, (3) imaging plant development like enclosed buds and (4) in the anatomical visualization of living insect specimens. Several international institutes are also now using nano- and micro-XCT for whole plant phenotyping, in time-series, using instruments that have a scanning deck large enough to accommodate whole plants and with specific environmental conditions. Plant biomass can now be evaluated above and below ground. We require and propose a facility for 3D X-ray Computed Microtomography (XCT) facility at the Ås NIBIO/NMBU campus to service the imaging of life science subjects, soils and materials science. The equipment and location at Ås campus is ideal for servicing the Life Science cluster and augmenting augmenting advances in the Bioeconomy. This facility will have a small set of four controlled environmental rooms alongside two XCT instruments to provide broad control over the parameters such as light, temperature and humidity. A bank of smaller cabinets will be provided for holding samples, or culturing growth. The facility will have a computing equipment to reconstruct, segment and analyse the data offline. That equipment will be a GPU accelerated and be capable of visualization with Virtual Reality (VR). The facility will be run together with a dedicated technical staff member. Two other pieces of equipment a standard 2D x-ray (eg Facitron Multifocus, for seeds, leaves) and a handheld X-ray fluorescence spectrometer (XRF) for the elemental analysis of different materials (eg. in soil).