AALBORG UNIVERSITY
DENMARK

DEPARTMENT OF CHEMISTRY AND BIOSCIENCE

EXPLORING THE BUILDING BLOCKS OF LIFE

ANNUAL REPORT 2017

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EXPLORING THE BUILDING BLOCKS OF LIFE

Research of the Department of Chemistry and Bioscience is diverse. We explore the building blocks of life to achieve new knowledge and provide platforms for industrial advances. The Department carries out education and research in chemistry, biology, biotechnology, environmental engineering and chemical engineering – including oil and gas technology. The research contributes to international state of the art and has impact on development of new technologies and products in industry.

THE RESEARCH AND TEACHING OF THE DEPARTMENT ARE ORGANIZED IN THE FOLLOWING SECTIONS:

- Biotechnology (Aalborg)
- Sustainable Biotechnology (Copenhagen)
- Chemistry (Aalborg)
- Chemical Engineering (Esbjerg)
- Biology and Environmental Science (Aalborg)

In both teaching and research we combine theory and practice and emphasize collaboration with companies and public sector organizations both nationally and internationally. The Department offers both Bachelor (Bsc) and Master (Msc) programmes as well as regular PhD courses. All teaching is according to the inter-disciplinary problem-oriented "Aalborg University model".

CONTENT

ANNUAL REPORT 2017

NEWCOMERS AND EXISTING STAFF

A university department is always evolving and 2017 is no exception. Leadership has been in focus. Section heads have completed a Learn2Lead course and received personal guidance. Some heads have decided to prioritize research and new heads have been found in Chemistry, Morten Lykkegaard Christensen and Biotechnology, Per Halkjær Nielsen. To take charge of strategic initiatives a vice-head of Department, Michael Toft Overgaard, has joined the leader team.

The demands for administration of teaching activities and external funding is ever increasing and good local leadership is important to provide transparency and efficiency. The lab support team and the secretariat are competent and offer invaluable support to the researchers. Once a month all leaders from Sections, Department, Study Board, and secretariat coordinators meet to address ongoing administrative matters and develop policies.

The Department budget has improved since the establishment of the new Faculty of Engineering and Science. We have employed new staff members: Peter Kristensen and Anders Olsen in Biotechnology, Mads Koustrup Jørgensen and Casper Steinmann Svendsen in Chemistry, Christiano Varrone in Sustainable Biotechnology and finally a 20% professor in Biology Martin Holmstrup. This provides a welcome addition to the teaching staff. It increases and strengthens our research and takes pressure off the teaching load.

EXCELLENT RESEARCH AND PUBLIC OUTREACH

We have celebrated several publications in Nature, microbial communities, and maintained a high publication record in general. Per Halkjær Nielsen obtained a prestigious Villum Investigator grant and Mads Albertsen a Villum Young Investigator grant. We have a good portefolio of grants spanning from basic science to applied research. Also direct collaboration with industry. One of our young researchers, Kristian Trøjelsgaard obtained an AAU talent grant. Our secretariat fund raising and project management support has matured into an excellent resource to assist our researchers.

Public outreach functions, our format for the yearly report has harvested praise and our research seminars have good attendance. The Department Committee in collaboration with communication provides the foundation for all outreach activities including the successful Department seminars.

TEACHING AND STUDY ENVIRONMENT

2017 will be remembered by some for the enormous work in connection with the accreditation of AAU. Endless pages of self-evaluations and meetings will hopefully lead to the final institute accreditation in June 2018. The department was selected for audit trail regarding the physical study conditions in Campus Copenhagen. We have an efficient study secretariat and we can pride ourselves with excellent study facilities and hope that this contributes positively to the final accreditation.

We have a large student population and the department has had focus on teaching quality and management of resources. One challenge is study activity the first year and initiatives such as quizzes are developed. Our efforts to develop cross campus teaching has borne fruit. Combination of different expertise add to the quality of our research based teaching. And promotes collaboration across campuses. The physical improvements on all campuses will support student interaction and provide a local social frame where students can work or relax between activities.

A PERSONAL NOTE

Finally, I will allow myself to end on a personal note. I will retire as Head of Department, March 2018 and can look back on 6 years in the company of Chemistry and Bioscience. Many changes have taken place and the Department is now in a strong position to meet new challenges and exploit new possibilities. Collaboration with industry and the posting of government research/advisory tasks, food, agriculture and environment provide new venues for substantial increases in Department activities.

The researchers in the Department have delivered an extraordinary effort beyond what is reasonable. The technical staff has lifted the practical challenges through terrible building processes in an exemplary fashion. The good working environment prevails and the loyalty across the Sections is remarkable. Problems are solved immediately and without questions in collegial fashion. I have enjoyed my many MUS and GRUS. The discussions with the young researchers have been valuable and it has been in the spirit of openness and enthusiasm.

Thanks to all employees for an exciting time as Head of Department!

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2017 IN REVIEW

ANNUAL DEPARTMENT SEMINAR

In its 5th year, the Department summer seminar took place at our premises in Copenhagen. In continuation of the new AAU initiatives and the recent division of the Faculty of Engineering and Science, the newly appointed dean, innovation director and head of the Doctoral School presented their future visions and goals for AAU. Also representatives from Villum and Lundbeck Foundations and the Danish Building Research Institute gave informative and inspiring talks on funding and their expectations to research leaders of the future. The social event included dinner and team building at "Flakfortet"- an island located in the middle of the Sound between Denmark and Sweden.

GUEST LECTURES

27 February Dr. David Berry, Department of Microbiology and Ecosystem Science, University of Vienna "New Single Cell Tools for Functional Analyses of Microbes in their Ecosystems".

30 March Cryo-EM Facility Manager and Associate Professor Thomas Boesen, Department of Molecular Biology and Genetics, Aarhus University "Recent Advances in Cryo-EM Structure Determination".

4 April Patent Manager Morten Ø. Jensen, Arla Foods "Intellectual Property Protection for Proteins in the Food Industry".

7 April Associate Professor Peter Kristensen, Department of Engineering, Aarhus University "Phage Display".

21 April Clinical Professor Søren Risom Kristensen and Chief Surgeon Benedict Kjærgaard, Department of Clinical Medicine, Aalborg University Hospital "Bleeding, Blood Clotting and Temperature – a Biochemical and Clinical Perspective".

14 August Professor Dr. Michael Wagner, Department of Microbiology and Ecosystem Science, Division of Microbial Ecology, University of Vienna "It's the Singer Not the Song: How the Comammox Discovery Changes our Perception of Nitrification".

16 November Dr. Lina Mercado, University of Exeter "Predicting Future Climate Change: IPCC, Climate and Vegetation Models, Climate Predictions and Uncertainties".

4 December Project Leader Torben Bramming Jørgensen, Limfjordsrådet "Limfjordsrådets aktiviteter".

Professor Hans Ulrik Riisgaard, SDU "Gopler i Limfjorden".

Professor Stiig Markager, Aarhus University "Limfjordens tilstand".

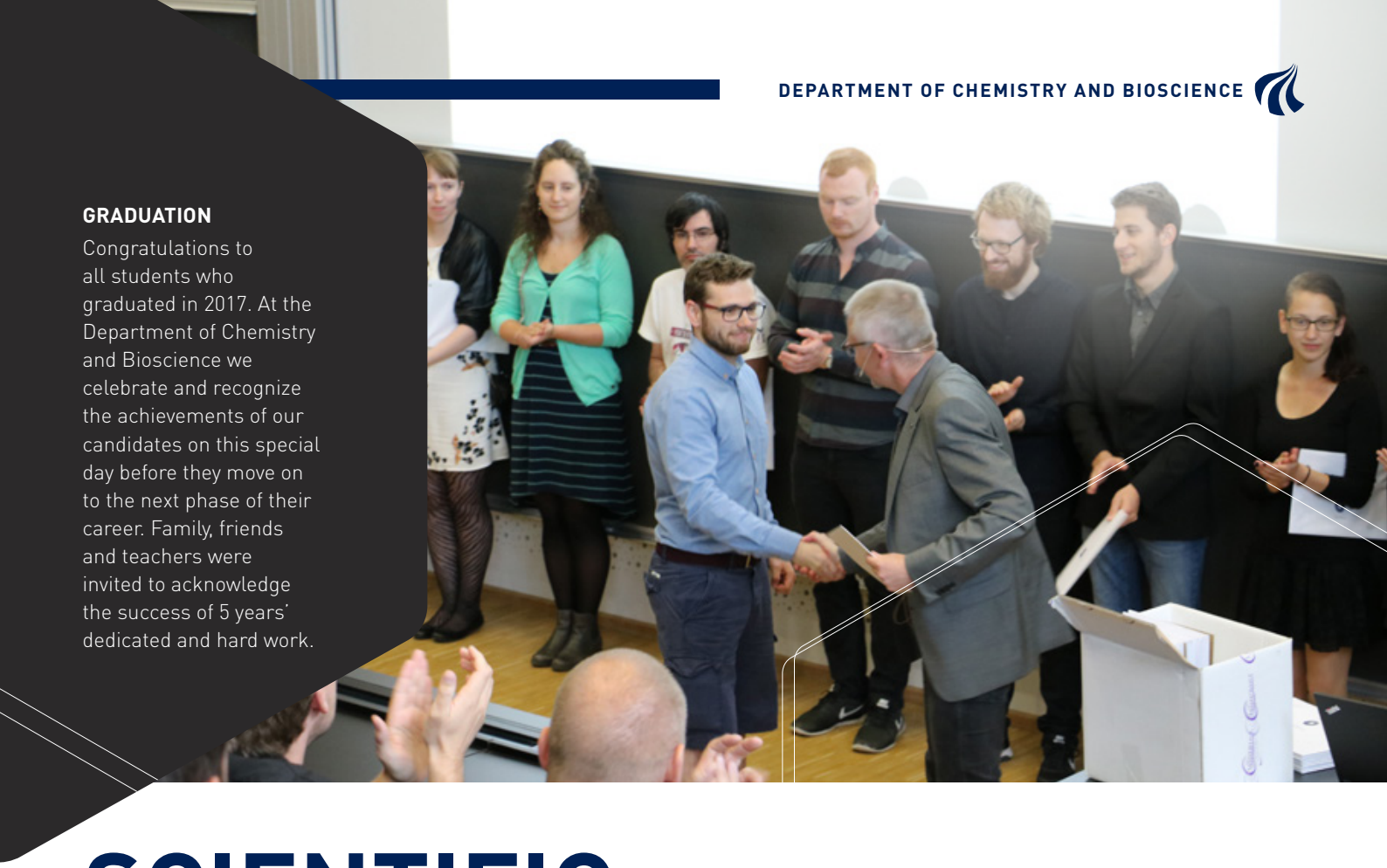
Head of Department Birthe Jordt, Ministry of Environment and Food of Denmark "Vand og naturovervågning i limfjordsområdet".

Vice Director Jacob Palsgaard Andersen, Aage V. Jensens Naturfond "Aage V. Jensens arealer i Limfjordsområdet".

Senior Researcher Torben Linding Lauridsen, Aarhus University "Søerne i Vejlerne".

Professor Jens Kjerulff Petersen, DTU "Skaldyr i Limfjorden".

Senior Researcher Preben Clausen, Aarhus University "Limfjordens betydning for fuglenes verdenskort".



GRADUATION

Congratulations to all students who graduated in 2017. At the Department of Chemistry and Bioscience we celebrate and recognize the achievements of our candidates on this special day before they move on to the next phase of their career. Family, friends and teachers were invited to acknowledge the success of 5 years' dedicated and hard work.

SCIENTIFIC SEMINARS AND INAUGURAL LECTURES

21 April we celebrated the inauguration of Adjunct Professor Jesper Haaning, Project Vice President, Novo Nordisk A/S "Development of Novel Therapeutics for Haemophilia Patients".

1 November the well-attended seminar "Science Fiction and what it has to do with Technoanthropology" introduced the Center of Bioscience and Technoanthropology and marked the release of the book "Science Fiction, Ethics and the Human Condition" by Christian Baron, Peter Nicolai Halvorsen and Christine Cornea. The book explores what science fiction can tell us about the human condition in a technological world, with the ethical dilemmas and consequences that this entails.

27 November we celebrated the inauguration of the Villum Young Investigator and Villum Investigator Programmes, respectively Associate Professor Mads Albertsen and Professor Per Halkjær Nielsen.

4 December the Department hosted a seminar "Limfjorden og oplandets natur – forskning og fremtidsperspektiver" with the purpose of debating the future challenges and development of the area. More than 120 people from industry, university and environmental organizations participated in the event which turned out to be a huge success. The seminar also served as a great stepping stone for collaborative research projects and teaching activities on Limfjorden.

AWARDS AND PRIZES

THE ELITE RESEARCH TRAVEL GRANT

PhD student Chao Zhou, Section of Chemistry, has been awarded the Elite Research Travel Grant for young researchers. The award is a personal grant of 200,000 DKK that allows the receiver to travel and visit research environments of relevance to the individual project.

VILLUM YOUNG INVESTIGATOR PROGRAMME

Associate Professor Mads Albertsen, Section of Biotechnology, has been awarded the VILLUM Young Investigator grant of 10 million DKK to explore the vast universe of microbes - research which may be of great importance to the production of bioenergy, food and useful enzymes. Purpose of the programme is to fund especially talented up-and-coming researchers in science and technology with ambitions of creating their own, independent research identity.

VILLUM INVESTIGATOR

Professor Per Halkjær Nielsen, Section of Biotechnology, has been awarded the VILLUM Investigator grant of 30 million DKK to develop his research in microbial communities revolutionizing our insights into the microbial dark matter. The aim of the programme is to support researchers who have the potential to make significant contributions to technical and natural sciences.

WORLD RECORD IN NON-BREAKABLE GLASS

Developing crack-resistant glasses has always been of great importance in glass science and glass technology. In 2017 Professor Morten Mattrup Smedskjær, PhD Student Kacper Januchta, Section of Chemistry, and colleagues published the discovery of novel melt-quenched lithium aluminoborate glass featuring the highest crack-resistance ever reported for a bulk oxide glass and thus setting the world record in non-breakable glass.

TEACHER OF THE YEAR AWARD

The Teacher of the Year Award annually recognizes and rewards teachers who have demonstrated excellence in teaching and whose efforts have inspired students and colleagues. Associate Professor Sergey Kucheryavskiy, Section of Chemical Engineering, teaches statistics and was nominated Teacher of the Year in 2017 for the second time in only a few years.

POSTER AWARD

At the "12th Pacific Rim Conference on Ceramic and Glass Technology" in Waikoloa, Hawaii PhD Student Tobias Kjær Bechgaard, Section of Chemistry, won 3rd place in a poster competition for students.

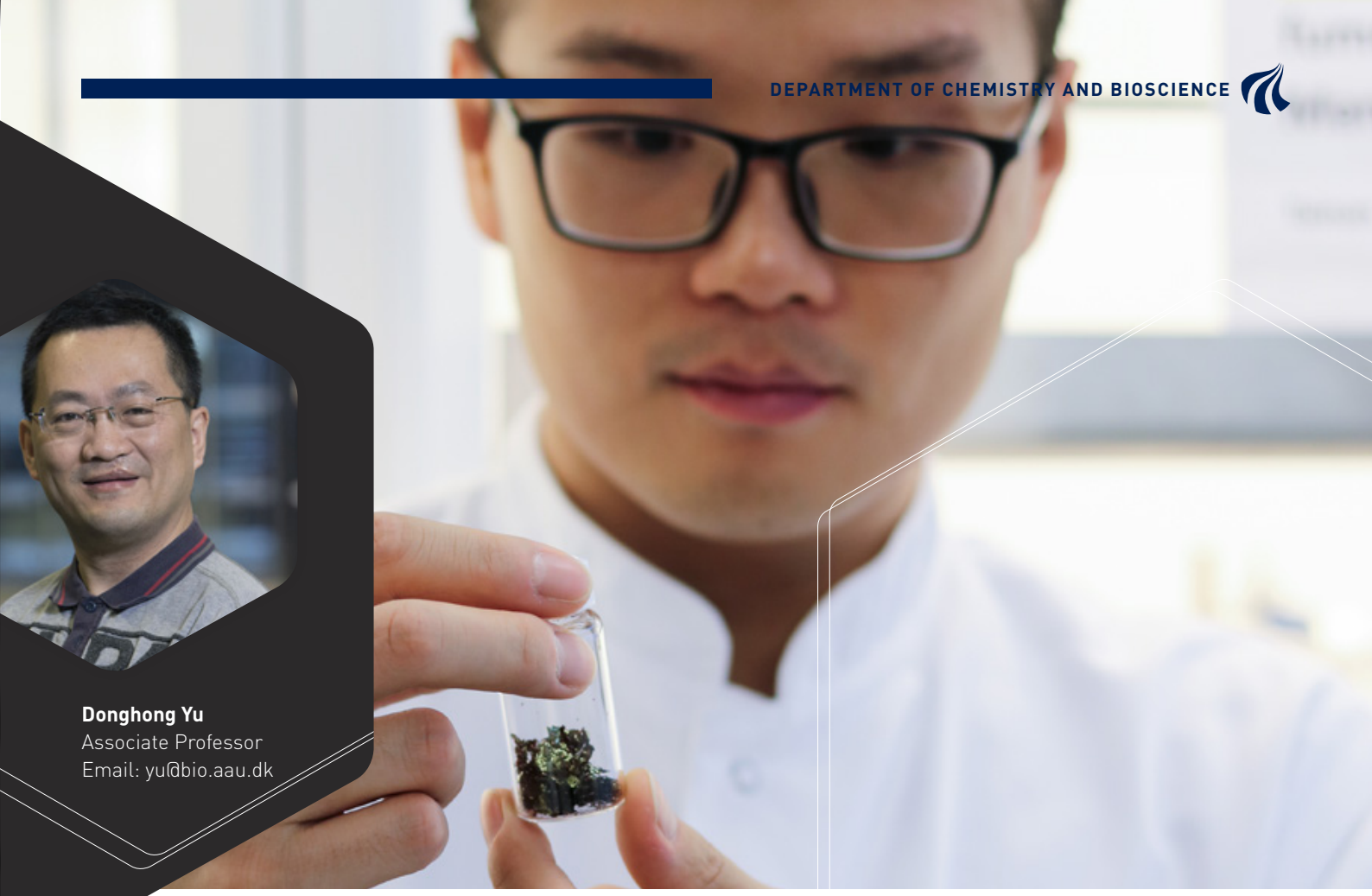
SIEMENS GRANT

Master Student Mads Skjærbæk has been awarded a Siemens grant of 27,500 DKK which allows him to invest in laboratory equipment for his master project "Characterization and Optimization of the OSE Concept" carried out under the supervision of Associate Professor Niels T. Eriksen, Section of Biotechnology.

RESEARCH

RESEARCH

SINO-DANISH COLLABORATION AIMING FOR WORLD RECORD



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RESEARCH

SINO-DANISH COLLABORATION AIMING FOR WORLD RECORD

At the Department of Chemistry and Bioscience in Aalborg, Associate Professor Donghong Yu works on revolutionising the efficiency of solar cells. In one of his current collaboration projects, he and his Chinese partners are approaching the world record.

Donghong Yu's field of research is organic photovoltaics – specifically, optimising the use and efficiency of organic materials in solar power cells for converting the solar energy into electrical power.

> ***In overall terms, I work with optimising solar cells in two contexts. In one project, I collaborate with a number of leading Chinese researchers through the Sino-Danish Center for Education and Research on optimizing the molecular design of solar cell materials to increase their efficiency, and in the other I collaborate with a number of Danish partners, including DTU, on improving a type of ink for polymer-based solar cells so as to make the manufacturing process cheaper and more flexible in order to expand the range of applications,"*** **Donghong Yu explains.**

CLOSE SINO-DANISH COLLABORATION LEADS TO IMPRESSIVE RESULTS

In terms of solar cell research and industry, China is now the leading player on the global market, and most of the solar cells that are bought and installed in Europe and in the US are now produced in China. When the Danish National Research Foundation opened funding for Sino-Danish research centres in 2010, it was a welcome opportunity for establishing close relations between the researchers at Aalborg University and solar-cell experts at Chinese universities and companies.

"The Sino-Danish Center for Education and Research is a close collaboration between China and Denmark where we have set up a Danish university in China for research-oriented education on both Master and PhD level for both Danish and Chinese candidates. The university has five themes, of which Sustainable Energy is one, and this is where our collaboration takes place. The students – Master's students as well as PhD students – researchers and lecturers at the university come from both Denmark and China, and we do both joint lectures, workshops and experiences in the lab when we visit," Donghong Yu elaborates.

The major focus of Donghong Yu's collaboration with the Chinese researchers is the development of organic solar cells.

"What we are aiming at is improving the materials used for transforming the solar rays into electrical power. The challenge is that we can produce these materials with optimized chemical structures that can be printed on flexible substrates like paper – but this does not necessarily guarantee a high level of efficiency when actually used in the solar cells. When talking about solar cells, a key figure is the so-called EPBT – Energy PayBack Time. This figure determines the time that the solar cell will take to produce as much energy as was spent in manufacturing it. In other words – how long does it take before the solar cell gives back to the earth?" Donghong Yu explains.

In order to shorten the EPBT, the researchers look to improve the efficiency of the solar cells by improving the chemical structures of the materials used, and in this area, they have seen rapid improvement over the years since their collaboration began.

"If we look at the starting point of our research, the efficiency of the solar cells we worked on was only a few per cent. But through our recent experiments, we have reached a result at close to 11% in May 2017- which means that we are getting close to the recent world record, set also in May 2017, which is at 13,1%," Donghong Yu states.

The researchers' progress has been noted all over the world, including in one of the highest-impact journals within the field: Advanced Energy Materials, whose impact factor is 16.721.

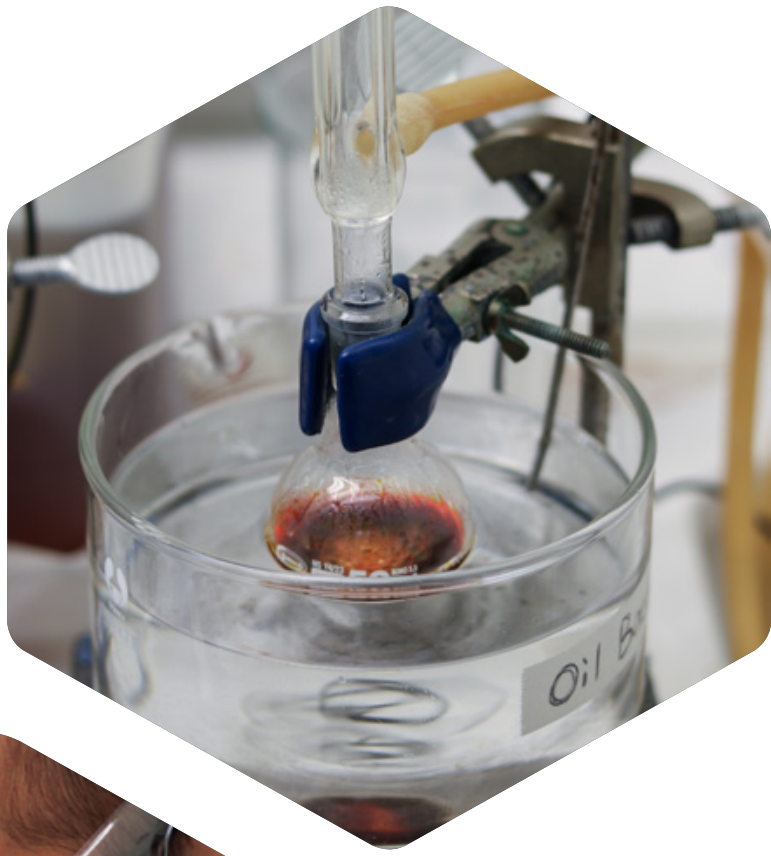
> ***We hope that the attention to our research will help us get continued funding for our work so we can reach an even higher efficiency level. At this point, the EPBT of commercial, silicon-based solar cells is maybe 2-3 years. This is quite good, considering that this type of solar cells is very durable and can be used for 30 years, but if we can improve the efficiency further and make the EPBT even shorter, we will be able to take a huge leap towards even greener energy production,"*** **he adds.**

EXPANDING EVERYDAY USE OF SOLAR CELLS

While the solar cells that Donghong Yu and his Chinese partners work on are traditional organic solar cells produced in glass, the solar cells he works on with DTU and the companies Grafisk Maskinfabrik and infinityPV are produced by printing a special kind of ink on plastic.

"In this kind of solar cell, the energy conversion takes place in ink printed on a thin layer of plastic. This means that the solar cells are highly flexible, can be easily produced – in fact, some of our test solar cells had been printed at the local Mekoprint factory years before – and can easily be produced in large quantities and for large areas. As such, they can potentially be used not only in a variety of everyday applications such as our mobile phone or a reading lamp, but also in power-plants for producing energy for electrical grids. The challenge for us now is to develop two things: One, a robust polymer for use in the ink that can increase the efficiency level to around 6-8 %, and two, a synthesizing process that enables a production of this polymer at an industrial scale," Donghong Yu explains and adds:

> ***While this type of solar cell is easy to produce, the disadvantage is that the efficiency is comparably low – only 3-4% – and they are not as durable as the other kind of solar cell; they last maybe 5 years. But when we look at the EPBT, this is still very good, because the easy production means that the solar cells have an EPBT of mere days – in fact, our goal is to shorten the EPBT to just two days or even, under certain conditions, one day. If we find a way to mass-produce the ink with an even more efficient polymer, and as such mass-produce this kind of solar cell, the potential is endless."***



HOPE OF TECHNOLOGIES CONVERGING IN THE FUTURE

Donghong Yu hopes that in the future, the results of his two research topics will converge into an even more efficient, environmentally friendly type of organic photovoltaic cell.

> ***Our highly efficient solar cells are currently only made at a very small scale in our experiments, while the flexible, plastic-based solar cells can be made at a large scale but have low efficiency. If, in the future, we can create organic, highly efficient solar cells – that is, also with the use of flexible substrates such as plastic – that are scalable and can be used in both local applications such as our everyday items but also at a major scale in factories or solar power plants producing electricity for the power grid, we will have made a major difference in the process towards a global conversion to sustainable energy,"*** **Donghong Yu finishes.**

RESEARCH

UNIQUE MOULD-BASED BATTERY MAY SOLVE THE GLOBAL ENERGY-STORAGE CHALLENGE

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RESEARCH

UNIQUE MOULD-BASED BATTERY MAY SOLVE THE GLOBAL ENERGY-STORAGE CHALLENGE

Energy storage is one of the major challenges of our society's conversion to sustainable energy sources, as the key to economically viable, long-term storage of energy produced by wind turbines or solar power cells has not yet been found. At AAU Esbjerg, an untraditional cross-disciplinary research collaboration may provide the answer to this global question.

Associate Professor Jens Laurids Sørensen's research focuses on mould fungi that produce various chemical substances that can be used for medicinal purposes, such as new types of antibiotics or cures for cancer. When he moved to Aalborg University Esbjerg in 2014, he ended up sharing an office with Associate Professor, chemical engineer, Jens Muff, whose research is in a completely different field, namely electro chemistry, which happens to be the core of battery technology. This has now led to a unique collaboration on a topic that may be the solution to a global challenge: Developing a highly scalable battery technology based on quinones produced by fungi.

AN ALTERNATIVE TO TRADITIONAL BATTERIES

Batteries basically function by having two reactants; substances of which one wants to deliver electrons to the other. This is a spontaneous process that happens automatically if the two substances meet. The process is utilized in batteries by separating the reactants in different chambers and forcing the electrons to move from one to the other through a wire. The generated electricity can then be used for powering items such as a lamp or a mobile phone.

"When the battery is dead, we charge it by applying voltage and making the reaction run the other way. Typically, the electroactive substances are not very environmentally friendly – usually we use metals that are both rare and constitute an environmental concern when we dispose of the batteries," Jens Muff explains and adds:

> ***" So when Jens suggested that he could provide some organic, potentially electroactive substances that are easily biodegradable, and which could also be produced in an environmentally friendly way by fungi, that could potentially be used for delivering and receiving electrons in a battery, I immediately saw the huge potential in the concept, and soon after we started developing the idea into a project proposal."***

The two researchers therefore have a very clear division of work in the project, as each has his very specific area of expertise. They now work on refining their respective tasks to fit the united whole optimally: Jens Laurids Sørensen works on identifying the optimal kind of quinones and maximising the production, while Jens Muff works on optimising the utilisation of the quinones in a battery.

TARGETED QUINONE PRODUCTION

While Jens Laurids Sørensen knew from the beginning that his fungi are capable of producing quinones, the process of identifying exactly which quinones are the optimal ones for battery use is far from a simple task.

"The fungi are capable of producing thousands of different quinones, so the first step is the basic identification of which will work best in this battery setup. For this purpose, we are collaborating with a researcher in Scotland who can perform advanced computer simulations to identify which quinones have the best electro-chemical characteristics and are at the same time durable for quinone production at an industrial scale. A PhD student supervised by Jens Muff will visit the researcher in Scotland to work on this simulation process, and hopefully their results will enable us to select the 20 most promising quinones that we can then test in practice in our lab," he explains.

After identifying which quinones to test, the next step is ensuring that the fungi used produce the exact quinones they want to test – a process that requires an element of what is by now fairly basic genetic engineering for the researchers.

> ***In order to make the fungi produce the exact quinones that the simulation processes have identified as promising, we need to identify the gene that is responsible for the production of that quinone, and then isolate that gene and insert it into our fungus strain, for instance a type of yeast. Then we need to determine the best way to increase the production – for instance by changing the chemistry of the container or by increasing the synthesis. We need to find the optimal conditions so that the fungi produce the substance we want in a large amount, but without producing a lot of other unhelpful substances that might impede or even be toxic to the fungi themselves,"*** **Jens Laurids Sørensen explains.**

The aim is to end with a fungus strain that provides a stable, prolific and scalable production of the exact quinones that are best suited to the batteries.

A POTENTIAL SOLUTION TO A GLOBAL CHALLENGE

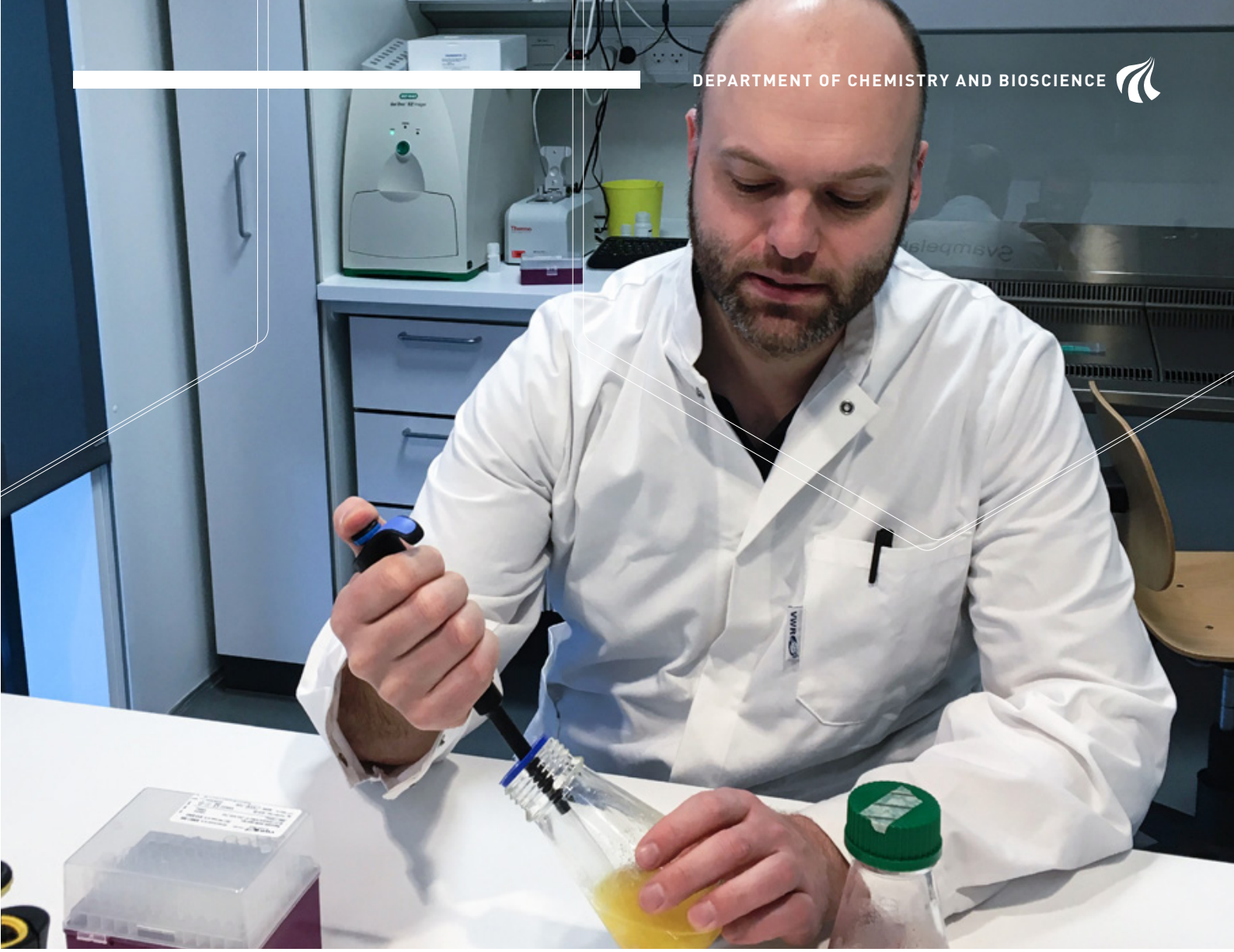
While Jens Laurids Sørensen works to improve the quinone production, Jens Muff works on optimising the battery setup for maximum flexibility and scalability. For this purpose, he aims to use an untraditional battery technology.

"One of the challenges of typical batteries is that the electroactive substances are placed inside the battery, which limits the size and weight of the amount of electroactive substances you can place inside your battery – and as such how much power you can gain from it. In the concept we work with here, we use the so-called redox-flow battery technology where the two parts of the battery are separated," Jens Muff explains.

In redox-flow batteries, the electroactive substances are placed in containers outside the electro-chemical reactor cell that contains electrodes, and which is the place where the actual electron transmission takes place.

"In our setup, we place our fungal quinones in large containers next to the electro-chemical cell, which allows us to scale the size of the containers according to how large power capacity we need. The separation of the electroactive quinones from the reactor cell furthermore allows us to pump the quinones through the electro-chemical cell whenever we need to, thereby triggering the electron transmission to either release power or recharge the quinones. Thus, we have much larger control of both how much of the electroactive substance we can have present; how much we want or need to charge the battery – for instance, do we need to store energy from a huge windmill farm or from a single-house solar-power-cell system – as well as how much power we want to release at any given point in time," Jens Muff adds.

> ***Being able to control these parameters provides redox-flow batteries with the potential to be used at a very large scale, but the only reason that we even dare to consider using them at the necessary scale is that the substances used are biodegradable and comparatively harmless. In theory, we can simply pour them out into the sewer system when we are done using them. If we were to use for instance Lithium batteries at the scale we are talking about, they would cause a catastrophe if they sprung a leak. What our setup provides is an energy-storage solution that is both sustainable, organically-produced, scalable and environmentally-friendly,"* **he emphasises.**



UNIQUE COLLABORATION LEADS TO UNIQUE SOLUTION

As a first step in the research on the fungus-quinone-based redox-flow battery technology, the researchers supervised groups of Bachelor's students who carried out tests of different elements of the battery setup.

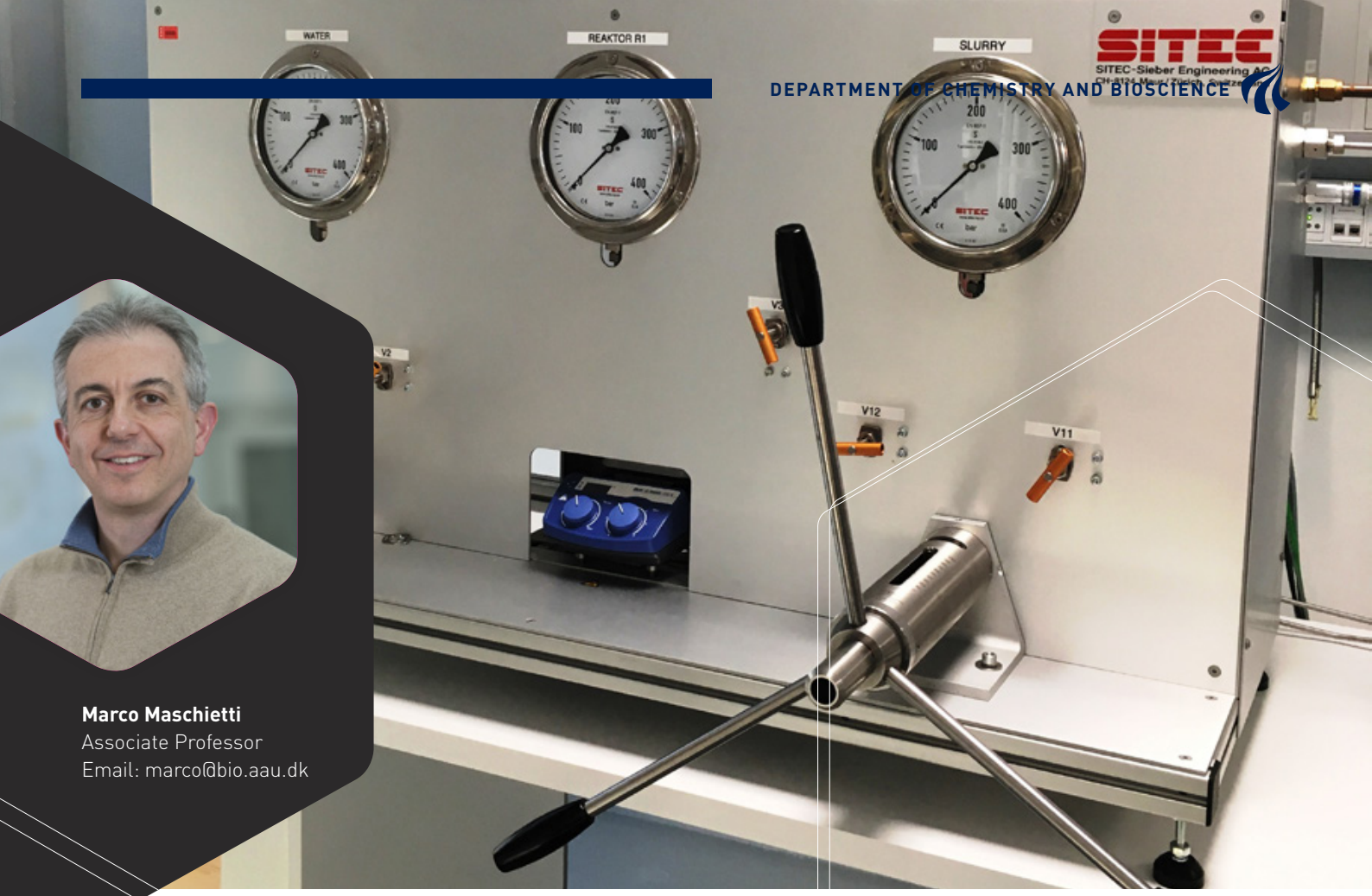
"Because of AAU's project-based learning method, our students are very experienced in terms of laboratory work, both in theory and in practice. This means that we could test elements of our idea through our student groups. I had groups focusing on the production of quinones from fungi, and Jens Muff had groups working on the battery technology. We also created a cross-disciplinary group of skilled Bachelor's students to test the setup at a small scale, which gave us a proof of concept that showed that it can actually work in practice. We used this proof of concept as one of the arguments in the project application that led to our recent grant from the Independent Research Fund Denmark for a four-year research project where we will be conducting research on the concept along with two PhD students," Jens Laurids Sørensen says.

The researchers have also submitted a project application to the Novo Nordisk Foundation along with a consortium of other researchers, including researchers from German and Scottish universities, as well as AAU's own Department of Energy Technology in Aalborg.

" ***While the redox-flow battery technology has been known since the 1970's, and a research team at some of the foremost American universities proved in 2012 that quinones can be utilised in batteries, as far as we know no one has created a fungus-quinone-based redox-flow battery in the way we are proposing. Energy storage is increasingly verbalized as THE challenge we need to solve in order for it to make sense to continue working towards using only sustainable energy sources in the future. We believe this technology can solve that challenge for major wind turbine farms and photovoltaic power stations all over the world, and the fact that it is both organically produced and biodegradable makes the battery technology itself a sustainable element in the global power production and consumption system. We hope that our recent research grant will be the first of many that will let us see energy storage by quinone-based redox-flow batteries become the key to global conversion to sustainable energy sources in the future,"*** **Jens Muff finishes.**

RESEARCH

HIGH-PRESSURE PROCESSES FOR SUSTAINABLE CHEMICAL PRODUCTION



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RESEARCH

HIGH-PRESSURE PROCESSES FOR SUSTAINABLE CHEMICAL PRODUCTION

At AAU Esbjerg, chemical engineer Marco Maschietti works to improve high-pressure and high-temperature chemical processes with a clear aim: To make industrial chemical production more sustainable and environmentally friendly.

Chemical processes develop in different ways and with many different output products depending on a variety of conditions such as temperature, pressure, solvent and added catalysts – as well as on innumerable potential combinations of these factors. By finding optimal ways of executing chemical processes, Marco Maschietti can help companies reduce costs, maximise yield – and find entirely new, more sustainable ways of producing products that we use in large quantities in our everyday lives.

LIGNIN: A RENEWABLE SOURCE OF EVERYDAY CHEMICALS

"I am currently working on a project focusing on converting lignin, a natural biopolymer that is one of the basic structural materials in many plants, into a range of chemicals that are currently being produced from petroleum. Vast amounts of lignin will be available in the future as a by-product of new biomass-based processes, but at the moment this by-product is under-utilised. It has, however, the potential of being converted into value-added products. This by-product is typically made available either dispersed in water or wet, and therefore it is particularly convenient to develop chemical processes that can convert it operating in water, so as to avoid the energy cost of drying," Marco Maschietti explains

"Our work focuses on finding new ways of converting lignin in water at very high pressure and high temperature – maybe between 150 and 400 degrees Celsius, but keeping the water in its liquid state because of the high pressure. We are in essence cooking the lignin to break it into smaller atoms, and when we dissolve lignin in water at these high temperatures, the structure of the polymer breaks and we get many small molecules. In addition, the process happens very fast under these conditions, and depending on the exact pressure and temperature settings, as well as which catalysts we add to the process, we can produce a range of very valuable chemicals from the lignin," he adds.

Historically, the production of vanillin, which we know from our everyday lives in the shape of vanilla aroma in products like ice cream, is the only lignin-to-chemical process that has reached commercialisation, but there is a great potential for producing a much wider range of chemicals, including building blocks for chemical products currently produced from petroleum, fuel additives, disinfectants, fragrances, etc. By producing these from a renewable source instead of from petroleum, the production will be much more sustainable and environmentally friendly. At the same time, the biomass used in bio-refineries can be utilised to an even higher degree than it is now.

> ***The major advantage of using lignin as a source of these chemicals instead of petroleum is that we have access to enormous amounts of lignin from sustainable and renewable sources. It is created as a by-product from biomass in bio-refineries, but the lignin is usually just burned to produce energy. However, there is a shared consensus among researchers that if the biomass and bio-refinery industry is to be more profitable and competitive, we need to do something with the lignin too; something that will give it a much higher value than just burning it to produce energy,"*** **Marco Maschietti says.**

A REVOLUTION OF THE CHEMICAL INDUSTRY

In order to study and refine the conversion of lignin, Marco Maschietti has collaborated with a specialist company to develop the design for a custom-made high-pressure, high-temperature chemical reactor. This new reactor is now available in the laboratories of the Section of Chemical Engineering in Esbjerg and here, Marco Maschietti can try out various combinations of pressure, temperature, catalysts and solvents at a higher level of accuracy compared to typical serial reactors commercialised for laboratory use. The new reactor thus allows for higher accuracy and results which are closer to those that could be obtained at pilot scale, and therefore more reliable.

"We are still quite a way from being ready to scale the processes to an industrial level, but our chemical reactor enables us to study the different aspects of the chemical reaction in order to improve the process," he explains and adds:

"At this point, we have shown at a laboratory scale that we are able to produce these chemicals. Now, we need to refine them further, for example to avoid by-products from the lignin conversion that either have no value or may do harm to the molecules that do have value."

He is convinced that the emergence of a lignin-based chemical industry will happen within the next couple of decades – and that it will mean a major change for the way we view the chemical industry.

> ***We are still at the very beginning of this process and need to do many more years of lab work, including work in a demo and test facility that is larger than our test reactor here, but once we show that a chemical production like this is feasible at a large scale – and can be competitive with the petro-chemical industry – we can prove that this kind of industrial facility is worth investing in. I am convinced that it will happen at some point, and it will not be an exaggeration to say that the full development of lignocellulosic bio-refineries will be a revolution of the chemical industry. It will be an entirely new but very important direction for this industry – you can compare it to the birth of the petro-chemical industry when it developed from petroleum production to all the fuels, fertilisers, chemicals and other products we know today,"*** **he emphasises.**

OPTIMISING OFFSHORE GAS AND OIL PRODUCTION

Marco Maschietti's expert knowledge on high-pressure chemical processes is also brought into use in an industry that some may at first glance see as oppositional to his lignin research; namely the oil and gas industry, where he works on optimising the separation of water, oil and gas at offshore platforms.

"The so-called 'separation train' takes place when the fluid from underground petroleum reservoirs reaches the offshore platform topside. Typically, the fluid arrives at the platform at high pressure, maybe 40 to 60 bars, and at a moderate temperature of 40-60 degrees Celsius. One of the first processes at the platform is to reduce the pressure of the fluid and separate water, oil and gas before they are transported onshore for further processing," Marco Maschietti explains.

In a project funded by the Danish Hydrocarbon Research and Technology Center, Marco Maschietti is working on how to optimise the operating conditions of this process.

"The reduction of pressure is usually done over two or three stages, but there are millions of possible ways to do it. Is it best to go from, say, 60 to 40 to 1 bar, or is it best to operate the separators at 30, 15 and 1 bar?" Marco Maschietti says.

> ***Optimising the separation train is crucial, because it determines how effective the separation of water, oil and gas is – and how pure the products are. For instance, we want to separate the ethane and methane molecules – the natural gas – from the oil, but we want to keep the components that have 5-6 carbon atoms or more in the oil. And we want to keep intermediate components like propane in the oil – but not in too large amounts, because then the oil gets unstable,"*** **he explains**.

COMPARING MILLIONS OF POTENTIAL SCENARIOS

Traditionally, the parameters for the separation train were determined by experienced engineers who had defined a number of rules of thumb for the best output, but with the advent of processing computers and the possibility of using simulation software, the researchers can analyse and optimise the potential separation processes in much finer detail.

"We study the processes that are described in the literature within the field by running them through customised simulation programmes to analyse the effect and efficiency of the different setups – and to determine how and where they can be optimised," Marco Maschietti explains.

"What we aim at is to show potential optimisation margins – including maximising the production of oil, minimising the energy spent on the different processes that are performed offshore, and increasing the purity of the oil and gas that are the result of the separation train. The aim is of course to cut overall costs and keep the price of oil competitive, but it is also to reduce for instance the energy used during these processes to make them more environmentally friendly. The less processing we need to do from oil well to end user, the lower the monetary and environmental costs of the oil production will be," he adds.

At this point, the researchers have been able to highlight some possible margins of improvement that they can present to the oil and gas industry and compare to actual working setups at the companies' offshore platforms.

> ***Whether or not our results will be implemented will depend on how feasible the realistic margin for improvement is – in other words, whether the oil and gas industry find it feasible to invest in further research and implementing our results. If the industry gives us the go-ahead for further investigation, we might see our results implemented within a fairly short timeframe, as the industry will not need to build new facilities but rather just change the parameters of existing processes to adjust and optimise them,"*** **Marco Maschietti says.**

COMPETITORS – BUT ALSO COMPLIMENTARY INDUSTRIES

In Marco Maschietti's opinion, the two industries that he works with may be competitors on the market, but that does not mean they cannot co-exist for many years to come.

> ***You could say that the two areas of my work seem oppositional at first glance, but I do not at all see it that way. On the contrary, I see them as complimentary industries. We will need oil and gas in our society for many years to come, but at the same time we need to develop the biomass industry and the processes for producing chemicals from renewable sources. The two industries will be running alongside each other, but in both cases we need to focus on increasing the efficiency and optimising the use of resources. This will, in the end, work towards a more sustainable and environmentally friendly chemical industry,"*** **Marco Maschietti finishes.**

RESEARCH

RESEARCHER BREAKS NEW GROUND TO IMPROVE SUSTAINABLE FISHING

Niels Madsen
Professor
Email: nm@bio.aau.dk

RESEARCH

RESEARCHER BREAKS NEW GROUND TO IMPROVE SUSTAINABLE FISHING

Fishing boats in the middle of the Atlantic, reefs in the Limfjord, streams and lakes in Northern Jutland – these are just a few of the places that constitute marine biologist Niels Madsen's everyday workplace.

"My field of research covers fish and other aquatic organisms, both salt water and fresh water. I primarily work with sustainable fishing, ranging from how fishing affects sea organisms and the ocean beds to resource utilisation, EU directives and strategies for fishing and the marine environment, but I also work with studying and protecting aquatic life in our local streams and lakes and, of course, the Limfjord," Niels Madsen explains.

He is currently collaborating with a number of fishing organisations on improving fishing technologies and legislation to heighten the sustainability of the fishing industry.

> ***At the moment, the majority of my work is focused on the question of discard survival rates – in other words, how many fish of a specific species survive if they are returned to the sea when caught because they are smaller than the minimum catch size limit. The EU recently introduced a ban on discarding fish, but that creates huge problems for the fishermen, since they only get a fraction of the price for these fish as they can only be sold for industrial purposes. In addition, if the smaller fish are returned to the sea, they can, one, grow to a larger size and have larger value if caught later, and two, contribute to the continued reproduction of the species if allowed to grow to spawning age,"*** **Niels Madsen says.**

Some species of fish can tolerate getting caught and then re-released into the sea, and the EU are working on an amendment to the directive that will permit discarding small fish of certain species – as long as there is scientific evidence that these species have a high discard survival rate.

"The first question to ask is of course, how do we prove the survival rate of species such as plaice and sole, for whom we expect a high survival rate? What we will be doing in practice is to collect fish from the fishing boats and place them in underwater cages to study their survival for a specific period of time. Once we have data on the survival of these species, we will work on getting approval for exempting these species from the discard ban. In other words – our results and data will be used for re-evaluation of the ban at EU level," Niels Madsen elaborates.

CROSS-DISCIPLINARY COLLABORATION ENABLES NEW FISHING TECHNOLOGIES

While working on documenting discard survival rates is one way to improve sustainable fishing, research on sorting fish according to size and species before they even enter the fishing nets takes up another major part of Niels Madsen's time. And in this work, he looks to both companies and other departments at Aalborg University to find specialised expertise and new technologies.

" ***In one project, I collaborate with the Funen company Sonos Aqua, who, with help from Faroese investors, have developed an acoustic system capable of encouraging fish to swim in a certain direction. Different fish species hear sound at different frequencies, which means that we can use sound to either discourage certain species from entering the net or encourage certain species to enter the net, depending how we point the acoustic waves. We will be testing this system at the Faroese Islands in November,"*** **Niels Madsen explains.**

UNDERWATER CAMERAS GIVE ACCESS TO UNIQUE DATA

Another technological advance that Niels Madsen has high hopes for is introducing new, intelligent technologies in the latest underwater cameras.

> ***I collaborate with Professor Thomas Moeslund at the Department of Architecture, Design and Media Technology here at AAU on automating the recognition of species of fish by intelligent camera technology. The potential idea is that intelligent underwater cameras can use image recognition to trigger a signal to the fisherman, so as to, say, assist the fisherman to optimise his fishery in terms of fuel savings and optimised haul, as he will be able to target his fishing to areas where the fish are present in large numbers,"*** **Niels Madsen says.**

As a first step in the use of underwater camera technology, Niels Madsen is getting information from experience and recordings from 50 cameras handed out to fishermen all over Denmark in order to assess the potential of the technology.

"We are hoping the researchers at Media Technology can help us in the future to find an automatic way to identify which parts of the hours of hours of footage that show fish to ease the process of sorting through these data as well," Niels Madsen says with a smile.

In addition to aiding the fishermen optimise their fishery, such underwater cameras and cross-disciplinary collaboration may also give the researchers access to crucial new data on the general state of oceans and fjords:

"The Kattegat and the Limfjord are very important in terms of protecting unique and sensitive areas, but there is a lack of full pictures of the state of the fauna on the sea bed floor out there. Research vessels are very expensive to use, so we are also pursuing new approaches in the shape of collaboration with the drone researchers at the Department of Electronic Systems on developing camera-bearing unmanned vessels that can sail either on the surface or underwater," Niels Madsen says.

"In general, it is very important to me to work cross-disciplinarily, and I am happy to have experts within for instance camera technology or drone technology so close that I can practically just drop by their offices," he adds.

INCREASED FOCUS ON LOCAL AQUATIC SYSTEMS

In addition to his work on aquatic environments at sea, Niels Madsen is also working on creating a bigger focus on the local fjord, both in his own research and in his students' project work.

"Having access to the Limfjord and the streams that lead into it from all over Northern Jutland, as well as the nearby lakes, is a gift to the students here at AAU. I collaborate with a range of the owners and managers of property along the fjord, including the Aage V. Jensen foundations and the Danish Nature Agency, on various problems within their areas," Niels Madsen explains.

One such problem is an imbalance at the lake Vilsted Sø near Nibe, which is filled with algae. As part of their fieldwork, a group of Bachelor's students supervised by Niels Madsen set out test nets to gain data on the composition of fish species in the lake.

"On the basis of their work, the students offered not just an explanation but also concrete suggestions for how to restore the balance," Niels Madsen says and adds:

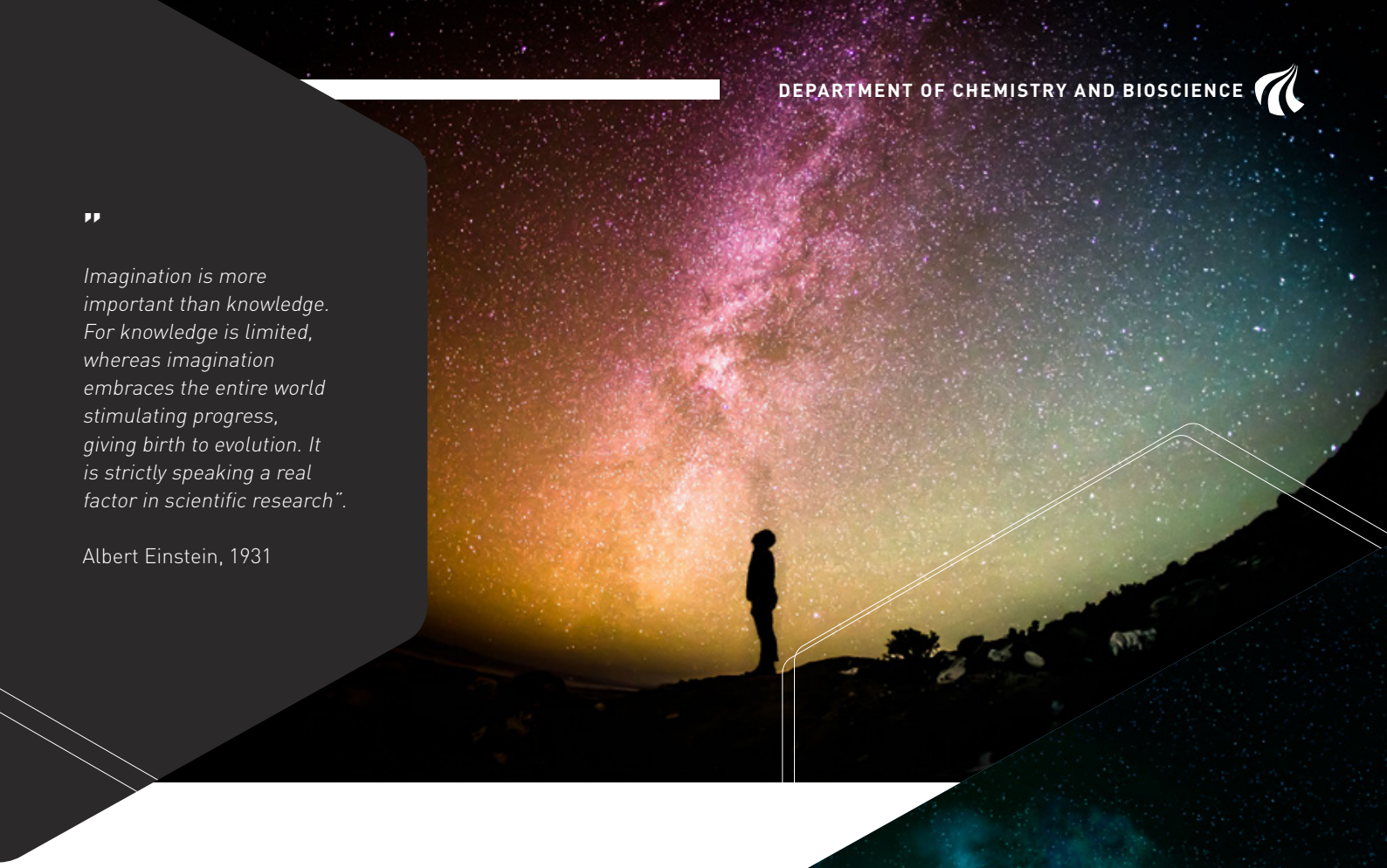
"The opportunity to collaborate with our students is being noticed all over the region: I have been working here at AAU for a little over a year, and already the local organisations have noticed how our students carry out valuable work. They have started contacting us if they have relevant problems or questions concerning aquatic life in the area, because they know we potentially have the manpower, laboratories and equipment that enable us to look into the issues thoroughly."

The researcher also hopes the local fieldwork will create value for the region for many years to come:

> ***This local focus in our student projects has the added benefit that our graduates often get employment locally, which means that in a few years from now, we will have a strong network of biology and environment graduates working in the Northern Denmark municipalities who already have a deep hands-on insight – theoretical as well as practical – into the areas they will be responsible for. I hope this will benefit not only our collaboration with the local municipalities and nature organisations but also the Northern Denmark aquatic nature as a whole,"*** **he finishes.**

To further this close local collaboration, the Department of Chemistry and Bioscience organised a conference on ensuring a sustainable Limfjord in the future in December 2017. The conference brought together relevant actors such as organisations, municipalities, researchers, property owners and managers of the Limfjord and adjacent nature areas with the purpose of furthering and coordinating future research and development activities along the fjord.

SCIENCE UPSIDE DOWN



"

Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world stimulating progress, giving birth to evolution. It is strictly speaking a real factor in scientific research".

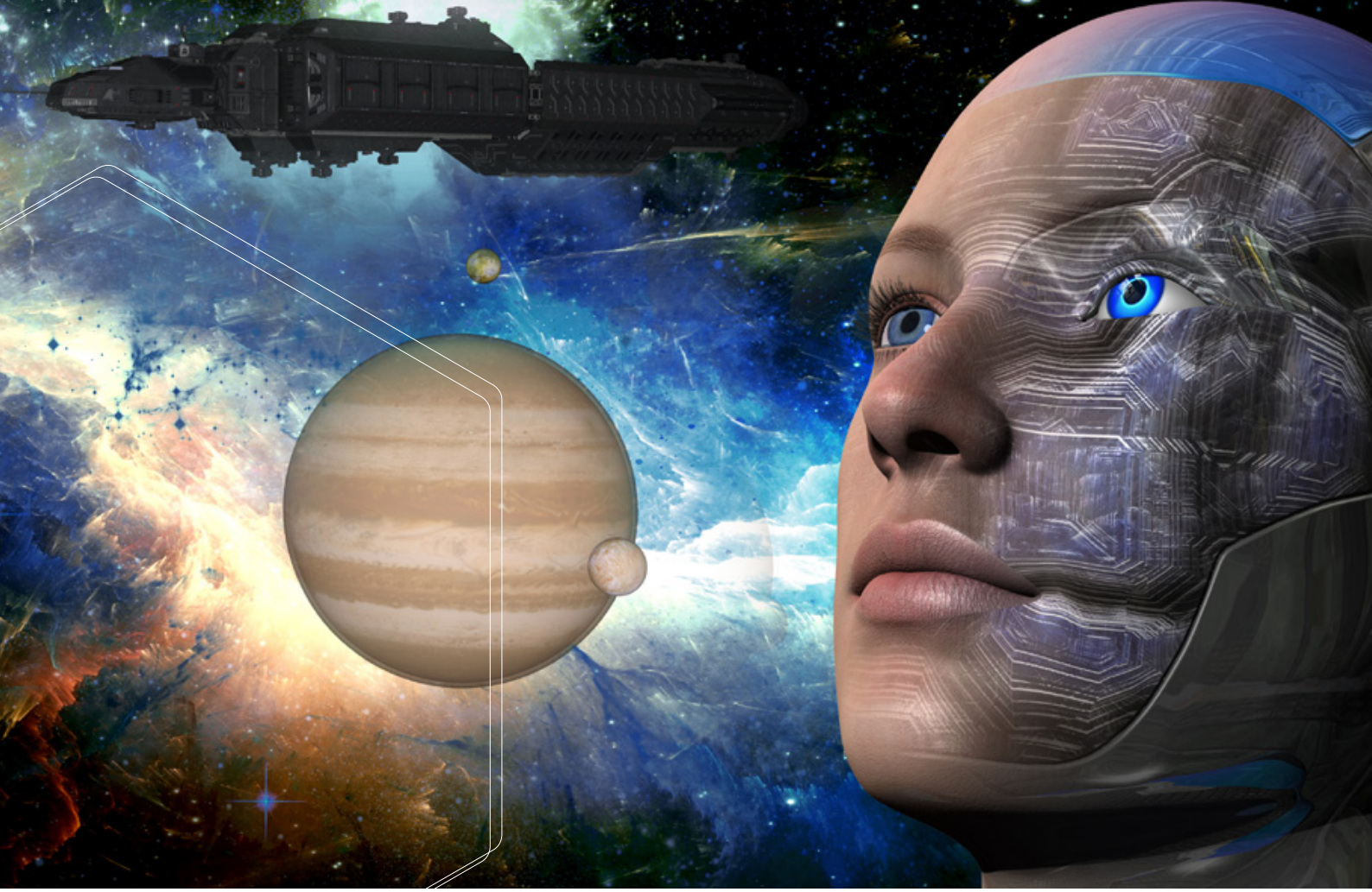
Albert Einstein, 1931

SCIENCE UPSIDE DOWN

CHALLENGING THE FRONTIERS OF INTERDISCIPLINARY COLLABORATIONS: TO SCIENCE FICTION AND BEYOND

CENTER FOR BIOSCIENCE AND TECHNO-ANTHROPOLOGY

When the Center for BioScience and Techno-anthropology was established at AAU campus Copenhagen in 2016 it came as a fairly natural extension of the strong involvement in the interdisciplinary Techno-anthropology program that was already a part of the teaching activities of the Section for Sustainable Biotechnology. In order to promote a stronger interdisciplinary research platform, the Center was organized as a joint venture between people with a background as classical biotech 'lab' research as well as people with a background in the natural science, but with interdisciplinary research profiles.



EXPLORING NEW WAYS AND PERSPECTIVES ON INTERDISCIPLINARY COLLABORATION

From the outset, it was decided that the Center's research activities, in addition to focusing on more classical interdisciplinary areas of inquiry (such as e.g. sustainable technology and environmental issues) should also seek to explore new ways and perspectives on interdisciplinary collaboration. Science fiction has proved a fruitful starting point for these interdisciplinary explorations. The main results of these efforts so far can be found in the edited collection Science Fiction and the Human Condition (Baron et al. 2017) - a collection of academic papers from international authors with diverse disciplinary backgrounds, including evolutionary morphology; biotechnology; philosophy of mathematics; public understanding of science, etc. The overall theme of this volume is to investigate what science fiction can tell us about the ethical dilemmas entailed by technological developments. But the various contributions also touch upon the relations between science fiction and public understanding of science as well as between science fiction and technological innovation. This focus on science fiction has led to several interesting spinoffs. The Danish Ethical Council invited Christian Baron to give testimony to the Council's working group on Deep Brain Stimulation on the virtues (and possible vices) of including science fiction as a tool for discussing future technological developments. This realization led Christian Baron into fictional experimental writing, which resulted in the Danish science fiction novel Happy Nation that appears among the Center's didactic publications.

USING SCIENCE FICTION TO INSPIRE SCIENCE INNOVATION

Most universities offer courses and workshops on innovation, which, however, mainly focus on product development and entrepreneurship in relation to start-up of companies, while education in creative and imaginary thinking, if not absent, has lagged markedly behind. The fundamental creative process in which the development of an idea is conceived, is largely left to the imaginary competences of the innovator. Science fiction is considered an increasingly important source of innovative inspiration for the technical sciences. Despite the numerous examples on how science fiction has predicted technological development and use (genetic engineering, mobile phones, synthetic food, the Internet, automatic diagnoses, longevity etc.) science fiction does not give directions on how to construct a specific organism or a machine, but establishes some plausible visions on how the future could develop, and the technologies, which could be a part of this future.

WHY IMAGINARY AND INNOVATIVE THINKING IS CRITICAL

A few institutions (mainly in USA) have actively incorporated science fiction as an inspiration source: "Center for Science and Imagination" at Arizona State University collaborates with companies like IBM and Intel using creative thinking and literature such as science fiction to support innovation and discovery. Massachusetts Institute of Technology runs a course in "Science Fiction to Science. Fabrication – or – Pulp to Prototype" coupling science fiction to critical ethical design to stimulate the development of new technologies. A limitation to the current initiatives is their main focus on "hard technologies" and to a lesser degree on e.g. biotechnology with respect to both ethics and to imaginary technologies. In the current century biotechnology is changing life as we know it. Problems, that a few generations ago belonged to solely to the realm of science fiction, are now entering the realms of everyday science and technology at an accelerating pace. This process puts new pressures on the scientists in the form of demands for an increased ethical sensitivity and responsibility and of non-conventional thinking and imagination. Cross-disciplinary merging technologies, that are not directly related such as solid state electronic technology and biotechnology in implant systems and bionics, and the increasing use of large-scale computing in biological modelling and analyses are challenging the classical identity of biologists and biotechnologists and also the imaginary and innovative thinking necessary to develop new products and processes.

OUR VISIONS

Within the Center for BioScience and Techno-anthropology we are, therefore, in the process of establishing a project dealing with imaginaries and (bio)technological visions. The project has two distinct purposes: 1) To integrate science fiction literature in the education of biotechnology engineers with respect to both ethical considerations and imaginary innovations. 2) To investigate how science fiction can contribute as a source of inspiration to (bio)technological research and how the inspirational flow between biosciences and science fiction takes place and can be optimized.

LEARN MORE

To learn more about Center for Bioscience and Techno-anthropology go to www.bio-ant.aau.dk

EDUCATION

STUDENT HIGHLIGHTS 2017

Clara Fernando Foncillas
10th semester, Sustainable Biotechnology

"In my Master Project (September 2016 to June 2017) I studied the applicability of osmotic membranes for the concentration of proteins and peptides from the OrganoFinery project, a sustainable biorefinery. The main objective was the use of forward osmosis on the brown juice, a waste stream that contains a high amount of proteins, as a second separation step to increase the recovery of proteins. I worked with two different forward osmosis membranes and studied their performance with Bovine Serum Albumin as standard protein, brown juice as stream of interest and sodium chloride as draw solution, obtaining successful results. As expected, many challenges arose during the experimental work, but these difficulties helped me to learn how to redesign experiments and overcome problems faster. I can surely affirm that osmotic membranes have a great potential and its use will ease separation processes in a great variety of biorefineries."

Lene Karoline Ejlersen
10th semester, Oil and Gas Technology

"My Master Thesis (September 2016 – June 2017) was done in collaboration between Aalborg University Esbjerg and Maersk Oil. The purpose of the thesis was to determine the scaling potential of all producing wells on the two fields Dan and Halfdan. To do this I had to develop a suitable method in the simulation software MultiScale, and collect all relevant input data from the wells. Furthermore, I had to conduct a cost benefit analysis to estimate the potential cost saving of continuously injecting scale inhibitor on all wells in the two fields. During my thesis period I was located at the Maersk offices in both Copenhagen and Esbjerg working closely with the chemistry team. This has provided me with valuable industry knowledge and experience. Additionally, it has given me a job opportunity with Maersk Oil in Esbjerg, where I will be employed as a Production Chemist in the Dan and Halfdan asset after my graduation."

Mark Larsen
10th semester, Biology

"I graduated from Aalborg university in January 2017, as a Master of Science in Biology and Sports Science. The aim of my Master thesis in biology was to study how the gastrointestinal microbiome (bacteria in the intestines) in five moose would be impacted by a relocating from two enclosures in Sweden to Lille Vildmose in Denmark. I used a technique called 16S rRNA amplicon sequencing to examine the moose microbiome. The tests proved that the moose had experienced a change in their microbiome after a year in Lille Vildmose. Additionally, the tests showed that the moose had more comparable microbiomes after the relocating. The technique can hopefully be a beneficial tool in future conservation programs. From August, I am employed at a high School in Aasiaat, Greenland. I look forward to teaching and experiencing living in another country with my family, which I see as a great opportunity."

STUDENT HIGHLIGHTS 2017

Peter Rendbæk
10th semester,
Biotechnology

"My masters project deals with rapid and mobile DNA extraction and is a central part of the large onsite and realtime DNA sequencing project at Aalborg University, which aims to enhance the performance of environmental biotechnology systems through online DNA surveillance of microbial communities. I developed and bencmarked a mobile lab solution that fits everything you need, to make the online and in-field identification of microbes possible, into a briefcase. To make DNA sequencing fast, I developed a method that cuts the time for DNA extraction by 90 % down to 10 minutes using a cheap off-the-shelf power tool with a 3D printed adapter to perform the cell lysis. The method developed in my thesis coupled together with the VolTRAX sample preparation device and the pocket-sized MinION DNA sequencer can provide a foundation for moving the DNA extraction and sequencing out of the laboratory and into the field."

A video of the DNA extraction can be found at here.

Pieter Cornelis van Rooyen
10th semester,
Chemical Engineering

"I had the opportunity to do a Long Master thesis (2 semesters) at Novo Nordisk A/S Kalundborg which involved me in one of their big projects with the ethanol recovery. I conducted experiments that not only supplemented missing information from literature, but also helped the project team get approval for the project by suggesting a more simple approach based on my experimental results. The great thing about doing a Master's in Chemical Engineering is that you don't have any classes the last 2 semesters so I was able to be at the company office or in the factory every day and get full exposure to a production environment. This also allowed me to integrate in the department I had my working desk and build a wonderful relationship with my colleagues. I was very fortunate that I was offered a job at Novo (in the same project team) even before I graduated and hence I started my first official day as a process engineer only 3 days after my last exam. None of this would have been possible if it was not for the high quality education Aalborg University offers as well as the PBL (Problem Based Learning) model that helps give projects practical value, especially for industrial partners."

GRADUATES 2017

BACHELORS OF ENGINEERING

Charlotte Høgedal
"Laboratory Test Methods for Assessing the Compatibility between Matrix and Glas/Carbon Fiber"

Steen Røn Stolberg
"Productionoptimization of the Pigments Extracted from the Fungus F. Solan"

Katrine Pierri Nørgaard
"Isolation of Bacteria from Danish Sub Sea Oil Wells and Microbial Degradation of Chalk Plugs by Use of Thermoanaerobacter Brockii Subsp.Lactiethylicus and Clostridium Tyrobutyricum"

Lonnie Deer
"Adhesion i Wood-Plastic Compsits - Investigation and Comparison of MA Grafted Polyolefins"

Mie Mandal Mortensen
"Purification and Investigation of the Presence and Activity of the Serine Protease AL-89 Expressed by Bacillus Pseudofirmus"

Steffen Ulrichsen
"The Potential of Forward Osmosis as Pretreatment to Struvite Precipitation for Phosphorus Recovery"

Christopher Vesly Nielsen
"Inline Electrocoagulation as a Pretreatment Prior to Dead-End Ultrafiltration"

Rasmus Sand Sørensen
"Low Temperature Glass-to-Metal Seal"

MASTER DEGREES

Thomas Yssing Michaelsen
"A Differentiation Dependent Classification of Diffuse Large B-cell Lymphomas by the NanoString Technology"

Anne Scheving Nielsen
"Assessment of the Effects of the Aalborg-Method on Streams Invertebrates"

Louise Brink Rasmussen
"Investigating Fitness Components in Six Populations of the Predatory Bug Orius Majusculus"

Sine Hedekær Hansen
"A Stock Analysis of Bone Mineral Density in Danish Stocks of Atlantic Cod (Gadus Morhua) and Fluctuating Asymmetry in Otoliths"

Helena Sif Ericson
"Exploring Landscape Connectivity with Genome-Wide Profiles: How does Genetic Structure in Romanian Wolves Contribute to the Divergence between Carpathian and Dinaric-Balkan Populations?"

MASTER DEGREES

Mads Krogh Ørtved
"Quantitative Assessment of Avian Avoidance Behaviour Near Wind Farms: A Case Study of Pink-footed Goose at Klim Wind Farm"

Julie Østergaard Markussen
"Quantitative Assessment of Avian Avoidance Behaviour Near Wind Farms: A Case Study of Pink-footed Goose at Klim Wind Farm"

Anna Elisabeth Rømer
"Wild Mammals in the Garden"

Søren Nøhr Thomsen
"Feeding Ecology and Saltwater Tolerance of the Endangered North Sea Hounting (Coregonus Oxyrinchus)"

Camilla Dahlgaard Astrup
"Foraging of Bumblebees"

Majken Elley Nielsen
"Lethal and Sublethal Responses in Daphnia Magna Straus (Crustacea, Cladocera) Exposed to Fluoxetine Hydrochlorid and Propranolol Hydrochlorid"

Anne Jensen
"Assessing Latitudinal Variation in Thermal Tolerance Traits, Hardening Capacity and Desiccation Tolerance in European Populations of Epidaphic Collembola, Orchesella Cincta (L.)"

Laurits Faarup Marcussen
"Behavioral Changes for Daphnia Magna under Influence of Selected Pharmaceuticals"

Rasmus Ejbye-Ernst
"Weight-Length Relationship and Condition of Northern Shrimp, Pandalus Borealis, in West Greenland Waters from 2005 to 2016"

Charlotte Jensen
"The Effect of Genetic Distance and Long-Term Consequences of Heterosis using Drosophila Melanogaster as a Model Organism"

Iben Vejrum Nielsen
"Present and Potential Distribution of the Invasive Pest Species Drosophila Suzukii: Species Distribution"

Mark Holm Larsen
"Modification af Moose (Alces Alces) Microbiome after af Translocation from Sweden to Lille Vildmose in Denmark"

Niels Ellekær Hansen
"Effects of Population and Photoperiod on Thermal Adaptation in Drosophila Subobscura"

Sara Amanda Lønning Pærremand
"Structural Determination of ACP from PKS6 of Fusarium Graminearum"

Oleksandr Grachov
"Determination of the Calmodulin F141L Protein Structure and its Interaction with Ryanodine Receptor 2"

Ina Møller Andersen
"Characterisation of Ca2+ Knock-Out CaM Variants"

MASTER DEGREES

Julie Klessner Thun Pedersen
"Correlation Analyses of the Microbial Communities in Activated Sludge"

Pernille Marie Høj Winther
"In Vitro Study of the Clinical Isolate Staphylococcus Aureus from Prosthetic Joint Biofilm Infection - Investigation of Antimicrobial Susceptibility Against Moxifloxacin and Comparative Transcriptomic Analysis of Biofilms"

Lonnie Maria Hansen
"Functional Amyloids in Methanogenic Archaea"

André Filipe Dias Xavier
"Increasing Expression Levels of an Active Recombinant Protease from Bacillus Pseudofirmus Strain AL-89 in Escherichia Coli"

Francesca Petriglieri
"Characterization of the Chloroflexi Community in Anaerobic Digesters"

Spela Pikl
"Profiling of Fungal Secondary Metabolites - a Search for Novel Peptide Drugs"

Mark Zver
"Design of Cas9/Single-guide RNA Gene Knock-Out System and Gene Expression Study of Cold-Induced Sweetening in Solanum Tuberosum"

John Kerr White
"Development of ITS Amplicon Sequencing for Detection of Fungal Pathogens in Clinical Pathogens"

Albina Valiavko
"Extraction and Analyses of Fucoidan from Fucus Vesiculosus"

Mads Skjærbæk
"Characterization and Optimization of the OSE Concept"

Kirstine Kløve-Mogensen
"Towards Molecular Understanding of Endometrial Function and Pathophysiology – Cytokine Profiling and Polygenetic Risk Score"

Carina Sloth Klitgaard
"Targeting Myosins - In Vivo study of Interactions between Human Type I Myosins and the Novel Fungicide Phenamacril"

Mathias Bonde Møllerhøj
"Mining for Novel Non-Ribosomal Peptides"

Peter Rendbæk
"Developing Methods for On-Site DNA Sequencing"

Kasper Skytte Andersen
"The Activated Sludge of Danish Wastewater Treatment Plants"

Ditte Starberg Jespersen
"Detection and Investigation of Alternative RNA Splicing in Diffuse Large B-cell Lymphoma"

MASTER DEGREES

Mads Heinrich Juul
"Expression, Purification, Characterization, and Fluorescence Labelling of Cysteine Mutated CaM"

Martin Villadsen
"Characterisation of Fusarielin Intermediates from the Iterative PKS9 of Fusarium Graminearum PH-1"

Charlotte Ellen Krogshave Laursen
"Investigation of Calmodulin Mutants and their Affinity for the Calmodulin Binding Domain of Ryanodine Receptor 2"

Oscar Mejias Gomez
"Screening of Natural Compounds with Modifying Effect on the Interaction between CaM-RYR2"

Maria Constanza Grassino
"Enhancing Wastewater Resource Recovery by Purple Phototrophic Bacteria Using Wet Oxidation Liquors as a Supplemental Carbon Source"

Clara Fernando Foncillas
"Use of Osmotic Membranes for Concentration of Proteins in a Sustainable Biorefinery"

Rocio del Rio de Diego
"Hop Resistance and Beer Spoilagepotential of Lactic Acid Bacteria"

Susanne Kate Lang
"Introduction of Reactive Groups in Polylactide through Co-Polymerization"

Anne Kristine Fledelius Frederiksen
"Effect of Substitution and Mixing of Network Modifiers in Aluminoborate Glasses: Structure-Property"

Jesper Houbak Sørensen
"Hybrid Osmotic Microfiltration Membrane Bioreactor for Wastewater Treatment and Nutrient Recovery"

Evy Gjerlev Christiansen
"Introduction of Reactive Groups in Polylactide through Co-Polymerization"

Rasmus Frandsen
"Molecular Imprinted Particles - Three Different Methodologies for the Specific Recognition of Saccharides in Aqueous Solutions"

Mátyás Tóth
"Estimation of Long-Term Resistance Changes in a Submerged MBR System Using Theoretical and Empirical Methods"

Trine Leck Kæseler
"Design and Synthesis of Block Copolymers with Cyclodextrin Moieties and their Capabilities to Form Nanoparticles for Drug Delivery with Applications in Cancer Treatment"

Pranas Vitkevicius
"Synthesis of Polylactic Acid"

Sofia Roura Garcia
"Validation and Development of a Method on the High Impact Tensile Tester"

MASTER DEGREES

David Ramos Perez
"Implementation of NIR for Atline and Online Monitoring of Citrem N12 Production into Plant Scale"

Pieter Cornelis van Rooyen
"Hazard & Kinetic Analysis of Nitric Acid used for pH Adjustment of Ethanol Solutions"

Pasquale Antonino Petrarulo
"Optimization of Offshore Oil&Gas Separation Train"

Ruben Bernard Roelofs
"Advancing the Use of Passive Gravity Flow Samplers for Storm Event Pollution Characterisation"

Christian Schel Klausen
"Phytoextraction of Cadmium, Zinc and Lead"

Daniel Palm Simonsen
"Influence of Constructed Wetlands on Downstream Water Quality. A Case-Study of Torsted Lake and -Creek"

Simon Vang Pedersen
"Nitrogen Removal from Torsted Lake Wetland - Quantification and Optimization of Denitrification"

Mugisa Yahaya Kano
"Vertical Zone Profiling of Formation Waters for Enhanced Oil Recovery"

Lene Karoline Ejlersen
"Dan and Halfdan Downhole Scale Potential"

Jhony César Quintal Nunes
"Caprock Integrity Study of the 2nd Wall Creek Reservoir: A case Study from Teapot Dome, Wyoming"

Ádám Bakó
"Partial Wet Oxidation of Guaiacol for Lignin Valorization"

Ana Carolina de Magalhães Gomes
"Modelling of Regeneration in Teg Natural Gas Dehydration Units"

Viken Màrk Kaprielian
"Partial Wet Oxidation of Guaiacol for Lignin Valorization"

György Imrenyi
"Modelling of Regeneration in Teg Natural Gas Dehydration Units"

Jacquelin Elizabeth Cobos Mora
"Caprock Integrity Study of the 2nd Wall Creek Reservoir: A case Study from Teapot Dome, Wyoming"

Bence Vizi
"Modelling of Regeneration in Teg Natural Gas Dehydration Units"

Manuel Ekkehard Tertsch
"Partial Wet Oxidation of Guaiacol for Lignin Valorization"

DOCTORAL DEGREES 2017

IN TOTAL 10 DOCTORAL DEGREES WERE AWARDED IN 2017.

DOCTORAL DEGREES

Muhammad Adeel Nasser Sohal, Chemical Engineering
"Enhanced Oil Recovery Based on Ionically Modified Water in Carbonates"

Søren Lorenzen, Chemistry
"The Isolated Effect of Particle Surface Charge on Filter Cake Properties"

Rasmus Hansen Kirkegaard, Biotechnology
"Novel Microorganisms and their Function in Anaerobic Digesters"

Elsa Sverrisdottír, Biotechnology
"Initiating Genomic Selection in Tetraploid Potato"

Katarzyna Ratajczyk Arturi, Chemical Engineering
"Value-added Products by Optimization of Solvothermal Liquefaction of Wastes"

René Mossing Thomsen, Chemistry
"Role of Alkali Calcium Aluminosilicate Glasses in Low Energy Cement"

Anita Asamoah, Chemical Engineering
"Assessment of the Contamination of Persistent Organic Pollutants in Breast Milk of Ghanaian Women from a Polluted Area in Accra"

Anja Sloth Ziegler, Biotechnology
"The Microbial Community in Fouling Membrane Bioreactors – Distribution and Diversity of Important Bacteria"

Mie Bech Lukassen, Biotechnology
"Off-flavour Producing Bacteria in Aquaculture"

Georgiana-Laura Paraschiv, Chemistry
"Structure and Physical Properties of Oxynitride Glasses"

EDUCATIONAL PROGRAMMES

CAND.POLYT.
Chemical Engineering
Biotechnology
Environmental Engineering

Chemistry and Biotechnology (BScEng.)

AALBORG

CAND.POLYT.
Chemical Engineering
Oil and Gas Technology

Chemistry and Biotechnology (BScEng.)

ESBJERG

CAND.POLYT.
Sustainable Biotechnology

Sustainable Biotechnology (BSc.)

CAND.POLYT.
Biotechnology
Medical Biotechnology

Biotechnology (BSc.)

CPH

CAND.SCIENT.
Biology

Biology (BSc.)

CAND.TECH.
Environmental Science

CAND.POLYT.
Environmental Engineering

Environmental Science (BSc.)

AALBORG

EDUCATIONAL PROGRAMMES

After the first year of study the student have the option to proceed with their first-choice study programme or to choose another programme of the Department of Chemistry and Bioscience

- Bsc.Eng. = Bachelor of Science in Engineering
- Bsc. = Bachelor of Science
- Cand.- Msc. = Master of Science

Chemistry (BSc.)

Chemical Engineering (BSc.)

Chemistry and Biotechnology (BSc.)

ESBJERG

FACTS AND FIGURES

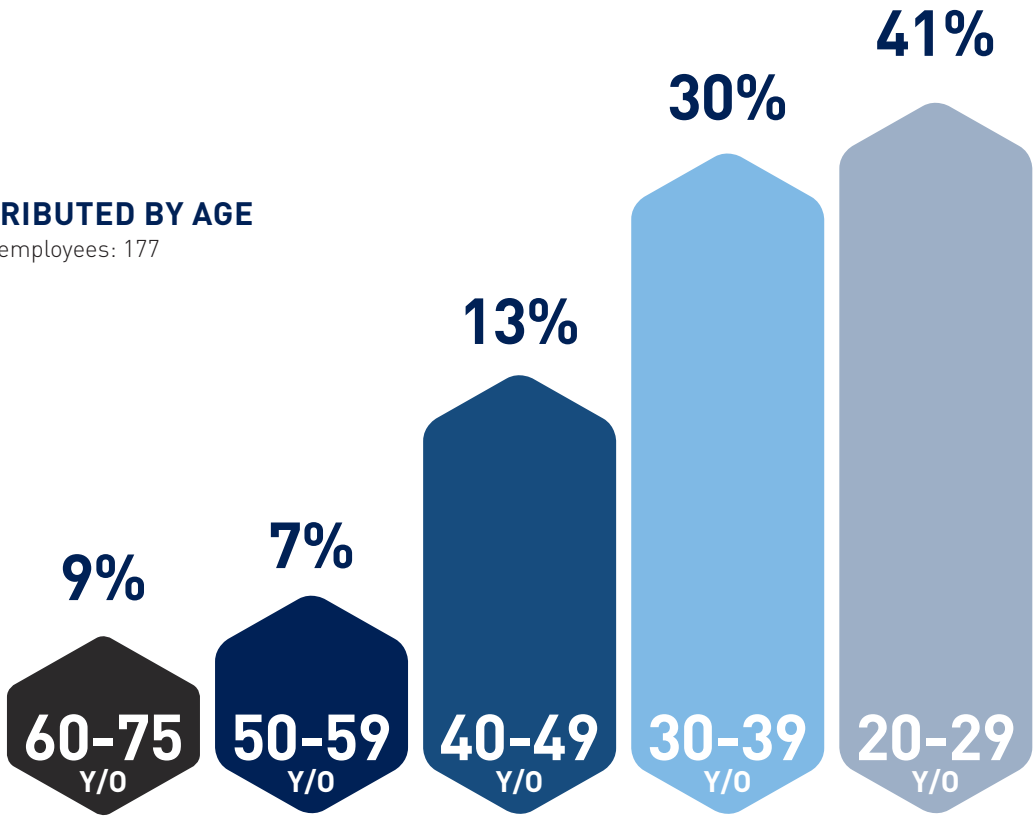
FACTS AND FIGURES

DEPARTMENT REVENUE

Total Department revenue 2017: 140.748 mio DKK

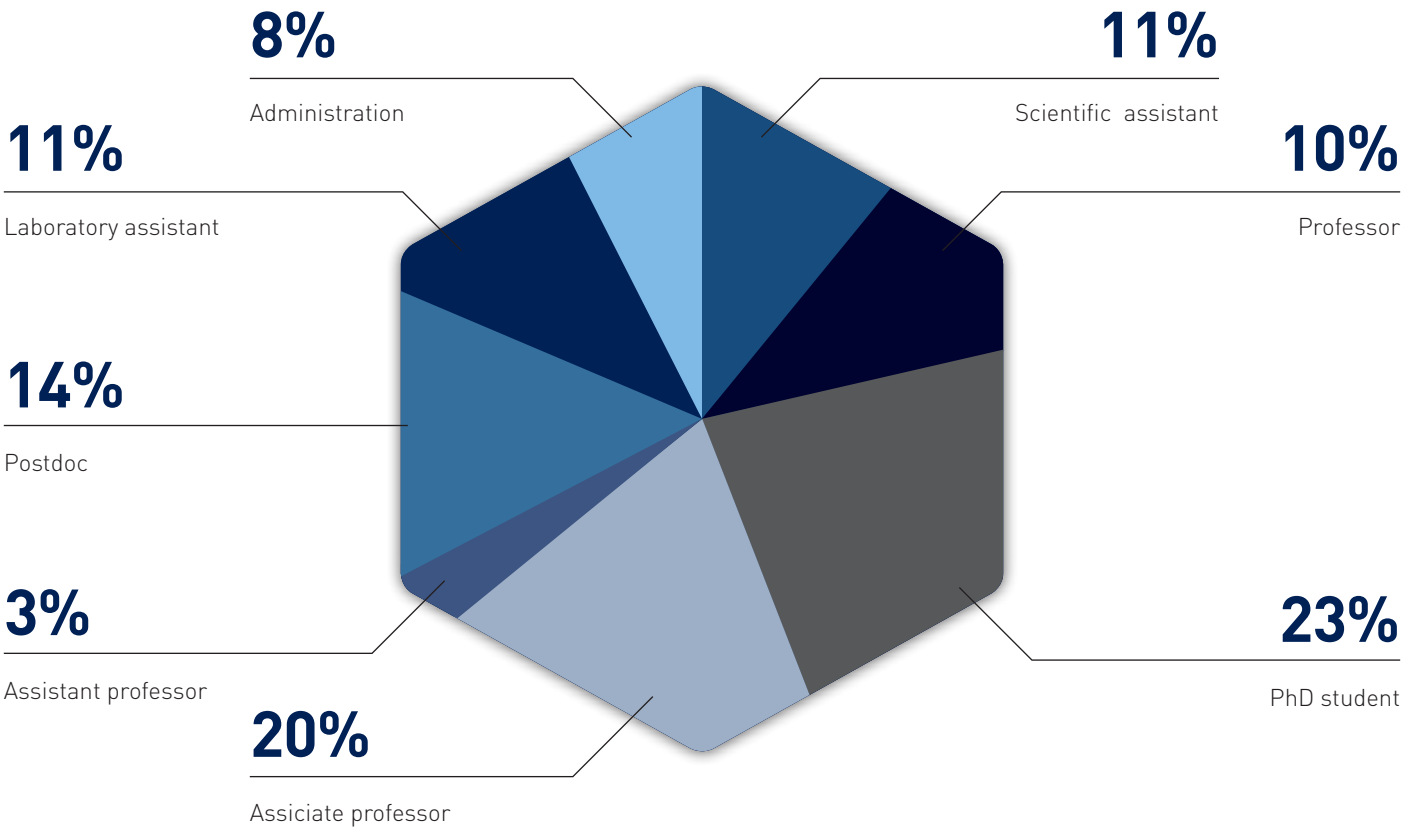
STAFF DISTRIBUTED BY AGE

Total number of employees: 177



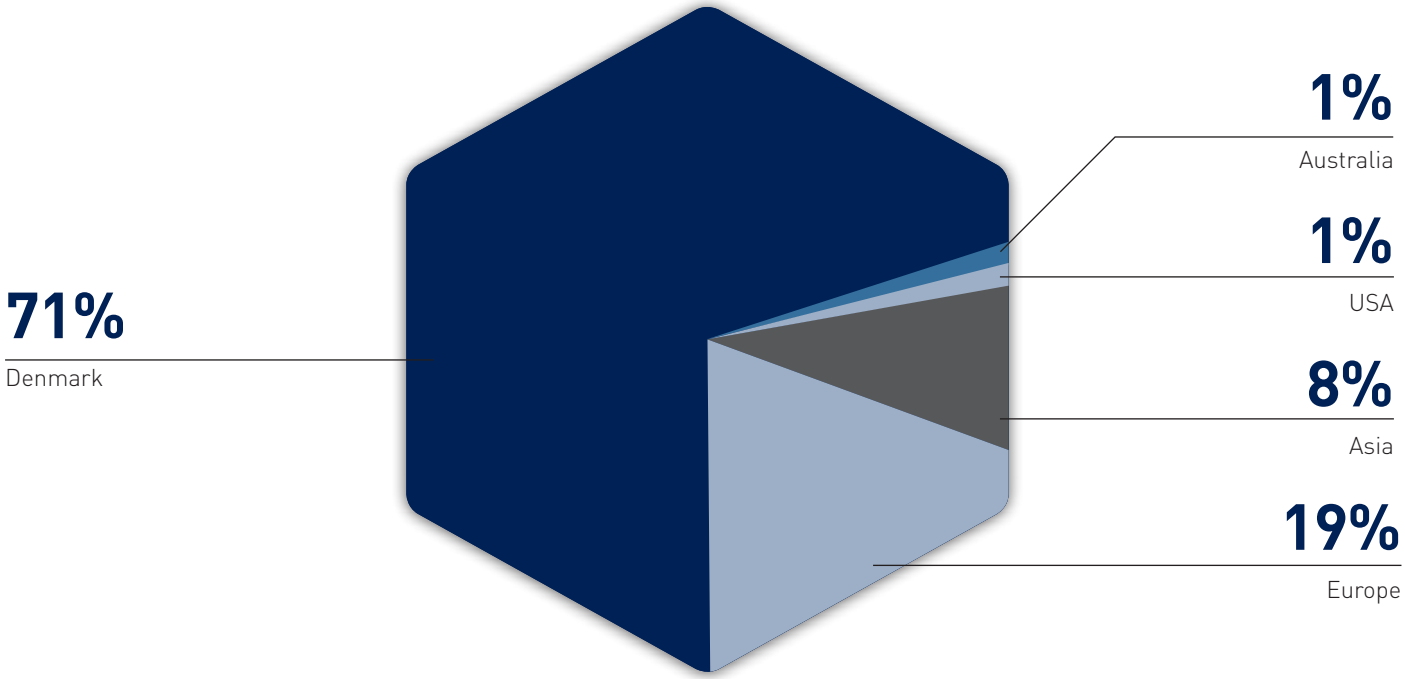
STAFF DISTRIBUTED BY PROFESSION

Total number of employees: 177



STAFF DISTRIBUTED BY NATIONALITY

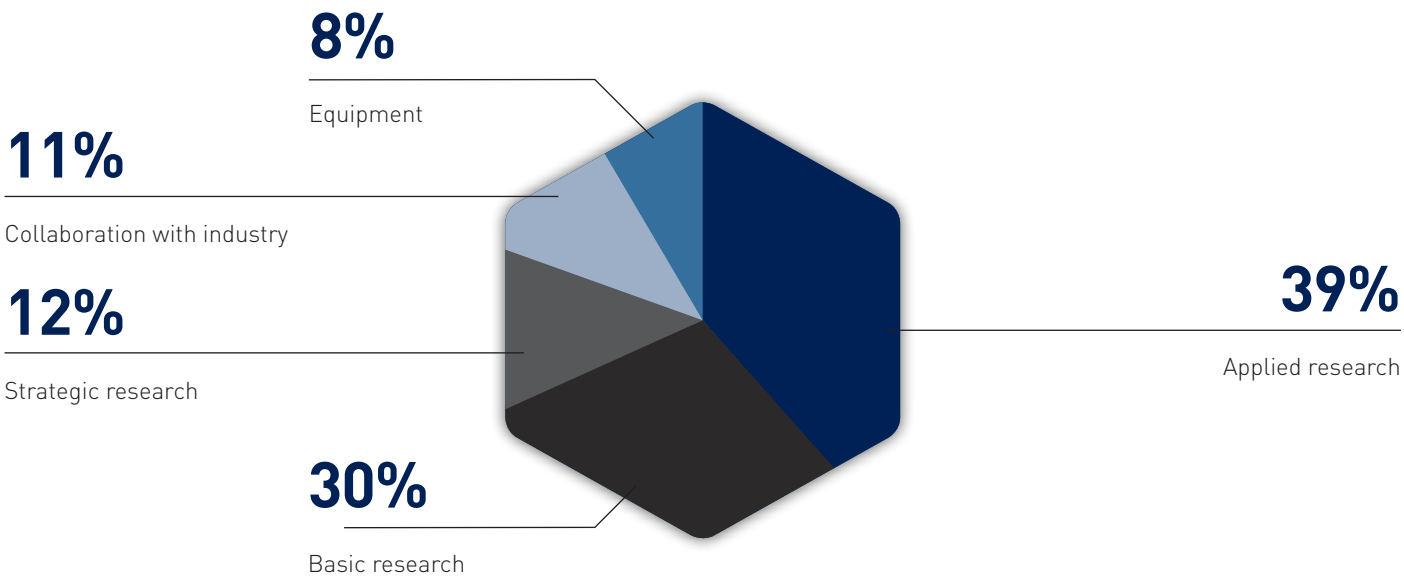
Total number of employees: 177



PROJECT DISTRIBUTION

Active projects 2017

The 2017 project portfolio comprised 140 projects supported by Danish Research Councils, sectoral public, private funds and funding from the European Union research programmes. The sponsorship of equipment has been maintained and cooperation with private companies increased in form of basic and applied research. In total, 40 new projects have been added to the project portfolio with a funding level of 85,207,000 DKK, which has increased by 30% in relation to 2016. The turnover of external funding increased by 17%.



Publications

RESEARCH AND INNOVATION

Scientific articles with referee in ISI-indexed journals (WoS)	160
Scientific articles with referee (not WoS)	30
Contributions to refereed conference proceedings [Peer reviewed abstract]	64
Monographs	1
Contributions to books	6
PhD Theses	10
Contributions indicated as popular	11
Scientific publications and conference contributions with no peer-review	18
Scientific reports	1
Patents	1

Education

TEACHING AND EDUCATION

Number of students (STÅ*)	576
Number of students	879
Completed BSc students	81
Completed MSc students	70
Completed Diploma students	8

*One STÅ is equivalent to one student studying full time for a year obtaining 60 ECTS

MANAGEMENT

MANAGEMENT

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