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# OPEN SCIENCE

PUTTING KNOWLEDGE TO BETTER USE



AARHUS  
UNIVERSITY



OPEN  
SCIENCE

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## WHY OPEN SCIENCE?

Scientific practice is often shaped by intense global competition for funding. It is also shaped by invention acts and reward systems that pressure the individual researchers to protect – rather than share – their data and results with peers, industry and societal stakeholders.

Most scientific papers are still “hidden” behind journal pay walls. They are kept short and focused, and they do not always offer sufficient information for other researchers or private companies to reproduce or build on the findings.

As a consequence, scientific results, data, codes and methods are not freely shared. This increases the risk of scientific misconduct – and it prevents great ideas from being put to good use.

### **How do we encourage the use of new knowledge?**

Fortunately, a movement has already begun to counteract this development at multiple levels and bring science back to its core values of openness and reproducibility.

Public funding bodies are encouraging grant beneficiaries to upload data and papers in open databases. And select universities have even established “open science” projects that share research per default.

At Aarhus University, we wish to contribute to this movement by taking things even further. We believe that open databases are not enough to ensure that scientific data will be used to benefit society.

### **Active knowledge adds value**

Sharing data in a database is not enough. Databases contain massive amounts of passive information.

In order to push the agenda of openness and sharing, the data need to be actively curated and communicated to e.g. industrial companies who cannot be expected to monitor the multitude of open data repositories out there – or to have the necessary insights to utilize the contents.

For this reason, we have developed an inclusive Open Science platform, that initially focuses on smart materials and nanocomposites. Here, researchers from many disciplines and industrial companies join forces

and translate broad industrial challenges into basic research projects together.

With no memberships fees – and easy access to informal discussions of results and their potential uses – even small companies get a chance to join and learn how fundamental research can benefit them. The joint effort of companies of all sizes effectively lower the risk associated with exploring “wild” ideas.

By engaging the companies directly in the ideation and research process, we increase the chances that

our shared efforts will result in industrial innovation. Although no one can patent the fundamental knowledge we create together, everyone is freely able to use the knowledge to subsequently develop and patent their own unique products.

The Open Science network is furthermore an ideal place to find collaborators for future traditional projects designed to further mature the technologies.

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## HOW IT WORKS

It is at the heart of Open Science to build a strong network, where academia and industry can be brought together to discuss relevant scientific issues. The network welcomes students, researchers, companies and anyone interested in the scientific field.

Within this network, we come together to identify current challenges shared by multiple industries and translate them into research projects that will show how things work on a fundamental level.

For instance, many industries are on the one hand dependent on durable and long lasting materials, and on the other hand challenged by a market demanding degradable materials in a movement recyclability and circular economies.

This paradox can only be addressed by fundamentally rethinking the materials from their atomic constituents – realizing durable materials, that can disassemble on command.

If we shed light on the underlying principles and causes of industrial challenges, we will open up a wealth of possible solutions and true innovation instead of just treating the symptoms with quick fixes.

That is why we aim to convert the broadly relevant challenges into **fundamental** research questions and projects. We create the knowledge foundation for radical innovation rather than incremental improvements. And we believe the open approach to science will accelerate the otherwise lengthy process from basic research to prototype.

Our projects are formed in response to industrial needs, and the results are shared online through an open database. This includes project descriptions, data, computer code, graphs and visualizations, methods, lab journals and more. Anyone can access these – *free of charge and with no use-restrictions.*

But the key to opening science really lies in direct collaboration. By engaging all interested researchers and companies in the projects, we hope to create “hive minds” that can increase the impact and quality of our

research and – in time – turn it into innovative solutions for whole industries and societies at large.

The partners meet on a regular basis and all play an active role in the projects that are carried out by students – including PhDs and Postdocs.

In this way, the projects draw from cutting edge knowledge from several disciplines and universities – and from the invaluable knowhow of market leaders.

Open Science is a new way of enabling an open discussion and sharing of knowledge across industries and academia. In turn, this will give industry a competitive edge and a research driven basis for developing the technologies, products and services of tomorrow.

## PATENTS AND OPEN SCIENCE

By solving industrial challenges in the realm of fundamental research, the results are positioned in a pre-competitive phase of industrial innovation. The simple legal framework of our platform dictates that no one can patent the open knowledge we create together.

Many companies find this approach particularly interesting. Because our projects create fundamental knowledge – and not mature commercial applications thereof – businesses can participate with no risk of sharing compromising business secrets.

In addition, the open approach prevents other companies from practicing obstructive patenting of fundamental knowledge (on e.g. processes) – with the sole purpose of hindering their competitor's from re-purposing the knowledge.

Companies are, however, free to file a patent for specific applications or develop innovative commercial solutions of the open science knowledge. In this way, Open Science is a window of opportunity for industries to bring fundamental scientific knowledge directly into their core business.

Participants bring knowledge into the projects on a voluntary basis. The patent- and barrier-free pursuit of fundamental knowledge serves as a pipeline for industry-driven projects, with a goal of applying this knowledge to a particular industrial need.

## SPOMAN – SMART MATERIALS WILL SHAPE TOMORROW'S BUSINESS

The Open Science concept is much more than a dream; it has already been put into practice with the Smart POlymer MAterials and Nano-composites community, SPOMAN.

SPOMAN aims to develop knowledge and concepts for new and gamechanging materials and technologies – that will enable Danish manufacturing to take lead in the global competition with cutting edge products, services and processes.

The SPOMAN open science platform involves 20 manufacturing companies from different industries and of different sizes. It has initiated a range of projects on very different topics in materials science.

Within these projects, researchers and students from universities have engaged with industries with common interests – understanding and identifying the smart materials of the future.

### **Within one year of operation, open science within SPOMAN has succeeded in (Nov. 2017):**

- Establishing a fast growing community with more than 150 participants
- Enrolling 25+ very engaged students for projects
- Engaging companies from many different industries
- Involving partners in 10 different specific scientific projects – one on the verge of leading to a new product already.
- Setting up a platform for open source instrumentation
- Creating informal relations between companies and researchers
- Hosting the first Danish Open Science Festival





## NEW MATERIALS FOR BONE-PROMOTING COATINGS ON IMPLANTS

Strontium (Sr) is known to promote the formation of bone. This has led to a number of coatings and surface treatments containing strontium, aimed at implants in contact with bone. A few studies have also reported an antibacterial effect of released strontium. A detailed mapping of the Sr-release is the basis for examining a possible combined antibacterial and bone-promoting effect of such coatings, and may revolutionize implants to have several functionalities all at once.

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ELOS MEDTECH

## NEW TYPES OF REVERSIBLE ADHESIVES FOR IMPROVED RECYCLABILITY

The demand for good adhesives is present in almost every manufacturing industry. However, the industries of the future cannot rely on incremental improvements. Introducing new types of adhesives that combine strong adhesion and reversibility on command will truly disrupt the field. This will pave the way for new possibilities in product design, bringing companies to the front of the competition, by pioneering the green transition and participating in a much more circular economy. Realization of this goal relies heavily on the need-driven fundamental research in SPOMAN.

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## IMPLEMENTATION OF FIBER MATERIALS IN 3D PRINTING MATERIAL

3D printing is currently becoming a key technology for innovation of the manufacturing industry. 3D printing is strongly in need of an expansion of the toolbox in terms of new printable materials with a variety of properties for specific applications. Research in potential 3D printing materials having extraordinary properties will open new avenues for the industry and allow individual customization of products such as shoe soles or automotive parts. This will enable local manufacturing to reduce heavy transportation.

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ECCO // NEWTEC

## GRAPHENE DISPERSIONS IN NEW ANTI-CORROSIVE COATINGS

Graphene is a material that receives a lot of attention, due to its potential to change properties of existing materials drastically. In a project in SPOMAN, the ability to prevent corrosion and water diffusion through coatings by introducing a graphene dispersion is investigated. Gaining this knowledge will widen the possibilities for implementing graphene in many areas as a game-changing additive for tailoring properties to the needs of the industry.

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*“Open Science aims to undermine some of the protectionism in both academia and industry. It aims to reclaim the virtues of what science ought to be. It should be transparent and reproducible. It should be open to the extent that anyone can freely access, draw from or build on the collective knowledge pool.*

*When many researchers, industrial companies – and even citizens – collaborate to solve societal challenges, odds are that the “hive mind” will come up with a sufficiently shrewd idea that will benefit us all.”*

**Professor Kim Daasbjerg,**  
Aarhus University. Instigator of SPOMAN

*“In order to drive innovation forward and maintain ECCO’s renowned pioneering position in the footwear industry, technology and know-how are of utmost importance. We see this initiative as a catalyst for generating valuable knowledge and a playground where new technologies can be sparked.”*

**Thomas Gøgsig,**

Head of Applied Research in Ecco – member of SPOMAN open science platform

*“The open science platform contributes to the innovative power of the companies, and can also help to boost interaction between researchers, students and the companies involved. By creating a platform that structures knowledge sharing in a way that deals with a number of practical and legal challenges, it will also be possible for smaller companies to be involved – companies that have historically encountered financial or cultural barriers regarding collaboration and the sharing of data and knowledge.”*

**Mads Lebech,**

CEO, The Danish Industry Foundation

## EVERYONE BENEFITS

Our Open Science initiative can lead to several types of benefits for its many different stakeholders.

### **Private companies:**

- Get easy and free access to cutting-edge knowledge for new products, services and processes.
- Recruit your new employee (our students)
- Have informal contact with a wide selection of world class researchers
- ... and with other companies
- Lower your risk of testing ideas for the gamechanging technologies of tomorrow

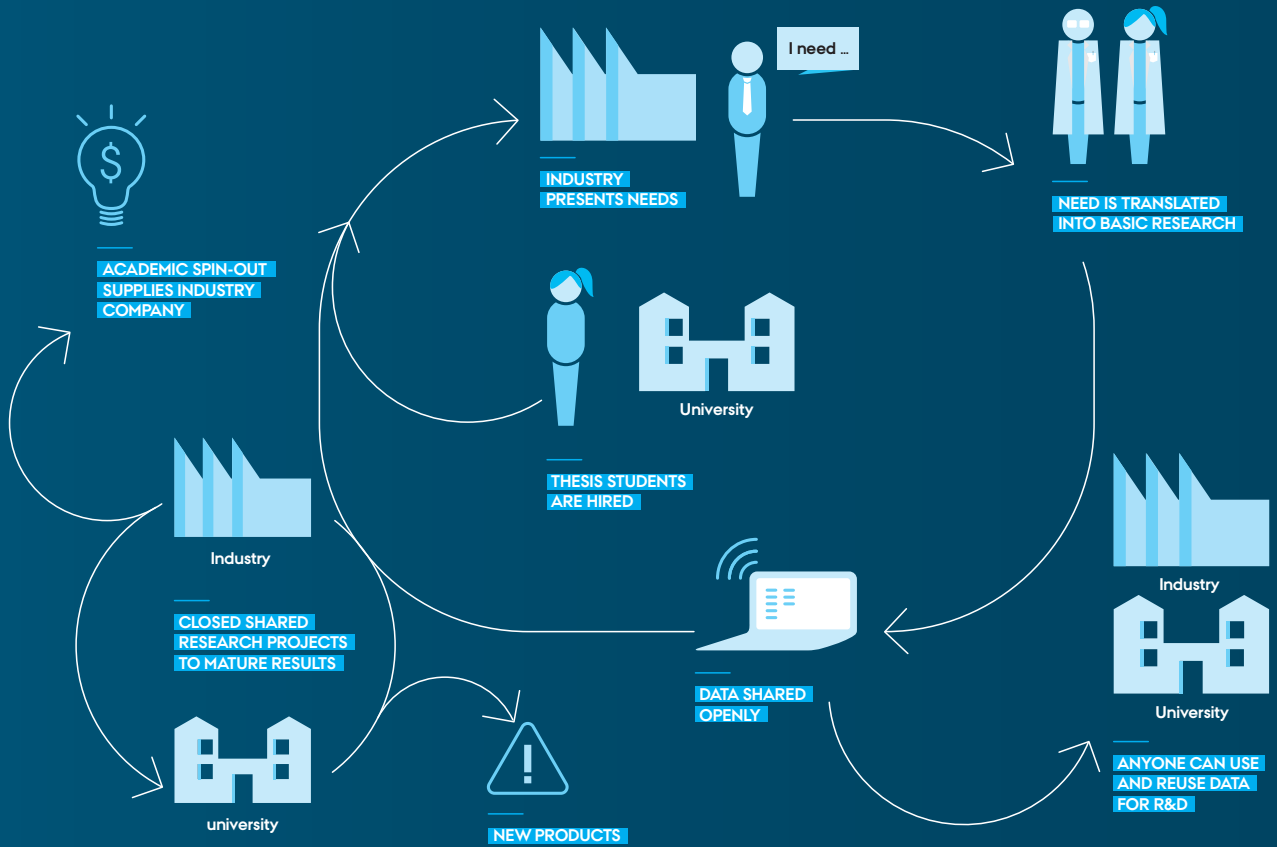
### **Benefits for SPOMAN researchers:**

- Cooperate with researchers from other groups and institutions
- Offer your students more than a traditional research project
- Meet industrial partners who might finance future projects.

- Increase your impact factor by co-publishing with industry.
- Have a community help you create viable, market-pull spin-out companies (your open science partners already ask for your product)
- Benefit from transparent and reproducible results – and get input from peers around the world.

### **Benefits for SPOMAN students:**

- Get trained in a highly interdisciplinary environment
- Boost your skills in need-driven problem solving
- Showcase yourself to private companies.
- Excel at science communication to different stakeholders.
- Increase your network in academia and industry.



## WANT TO KNOW MORE?

So do we.

That is why we have established the Knowledge Centre for Open Science (KNOCOS). The centre evaluates and documents the impact of SPOMAN and any other platform that may follow in its footsteps.

We want to know how open science affects the quality of academic research, the career opportunities of the individual researchers, and the research groups' ability to attract external funding? And how easy access to knowledge, talent and collaboration can lead to more innovative products, services or processes for our industrial partners?

We are always looking to collaborate with researchers, industry – and other open science initiatives – from around the world. By doing so, we hope to collect and create knowledge on the benefits and challenges of “Open Science” in its many different forms.

And naturally, we are more than happy to share our findings. So please don't hesitate to contact us:



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## WANT TO JOIN?

Joining the existing open science platform, SPOMAN, is free of charge. For more information, please contact:



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Instigator of SPOMAN

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