KTH Chemical Science and Engineering

Division
Wood Chemistry & Pulp Technology

Professor Monica Ek

KTH Chemical Science and Engineering

- **Monica Ek**
  Division manager
  - **Mikael Lindström**, Prof. Dean of CHE
    Pulp Technology
  - **Gunnar Henriksson**, Prof.
    Wood Chemistry in biotechnology
  - **Olena Sevastyanova**, Assoc. Prof.
    Utilization of lignin in value-added applications
  - **Elisabeth Sjöholm**, Assoc. Prof.
    Carbon fibers based on lignin
  - **Dongfang Li**, PhD
    Efficient preparation of cellulose nanocrystals
  - **Yadong Zhao**, PhD
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  - **Anna Ottenhall**, PhD student
    New concepts in lignin valorization
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  - **Chao Chen**, PhD student
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  - **Tianxiao Huang**, PhD student
    Functionalized cellulose based textile fibers
  - **Jonatan Henschen**, PhD student
    Surface-modified films for advanced packaging
  - **Ayumu Tagami**, PhD student
    Characterization and chemical modification of technical lignin
  - **Göran Gellerstedt**, Prof Emeritus
    Pulp and paper research

About Us

The research in our division is focused on the wood biorefinery concept, i.e. fractionation, characterization, modification and evaluation the chemistry of the wood components. The goal is to use more renewable wood based resources to make new products or substitute conventional products, today made from oil based materials, to increase future sustainable product applications. The wood based fibres will have a bright future in many material appplications such as textiles, pharmaceuticals as well as different types of biocomposites.

Monica Ek - Professor, KTH

Wood Chemi stry is the future of renewable products

One example of this is discussed in Dongfang Li´s Ph D thesis (2015). The research on birch bark has proven that it is possible to convert birch bark to sustainable materials by new green production technology and chemical treatment.

We believe in a future of greener science

We Develop Material and Chemical from Forest Resources

PULP TECHNOLOGY

The pulp technology treats most of the processes and techniques that are used to uncover fibres from wood. The fibres are primaryused as raw material for paper and cardboard production but also for some other products in for instance life science and the textile industry.The research includes modelling and simulation methods for analysisof the different unit steps during pulp production. The research also includes how the properties of the final product are affected by different process steps, which fascilitates an effective usage of the wood fibre.

Gunnar Henriksson
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WOOD CHEMISTRY AND BIOTECHNOLOGY

I have a background in basic research in cellulose, lignin and pectin biodegradation and have in recent years engaged myself in lignin biopolymerization. Furthermore, I have been involved in biotechnological processing of flax fibres for textile purposes, and the use of enzymes in pulp and wood analytical chemistry. Here I got experiences in the combination of enzymatic and chemical treatments. I am also teaching in wood chemistry and wood biotechnology.

Gunnar Henriksson
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UTILIZATION OF TECHNICAL LIGNINS IN VALUE-ADDED APPLICATIONS

Specialist in wood chemistry and fibre technology, with extensive research experience in lignin and carbohydrates chemistry, biomaterials development and characterization, chemical pulp manufacturing, bleach processes and quality control. I work on wood isolation, upgrading and modification of technical lignin to use them in various materials. Currently, I act as a manager of Wood and Pulping Chemistry Research Network(WPCRN).

Olena Sevastyanova
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CARBON FIBER FROM LIGNIN

I devote myself to attempting various methods to make carbon fiber from lignins. The replacement of construction steel in cars and trucks with a much lighter carbon fiber-based composite will ultimately result in more fuel efficient vehicles. To replace the precursors of carbon fiber, polyacrylonitrile(PAN), or other non-renewable materials such as pitch, by cheap (kraft) lignin, a comprehensive understanding of the physical and chemical characteristics of lignin and the development of methods for its homogeneous large-scale production must be achieved.

Elisabeth Sjöholm
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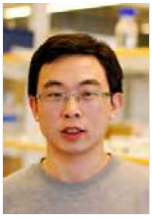
EFFICIENT METHOD TO PREPARE FUNCTIONALIZED CELLULOSE NANOCRYSTALS

My research aims to create a quick and simple method to prepare functionalized cellulose nanocrystals(CNCs)with high yield. A simple solvent-free modification of cellulose was carried out to produce cellulose derivatives. CNCs were made from the aqueous suspensions of cellulose derivatives through sonication, and films can be prepared by solvent-casting of the aqueous suspensions of the CNCs.

Dongfang Li
dongfan@kth.se

Materials based on tunicate

The aim of my project is to explore chemical components from the sea animal-tunicate and apply it in industrial products. Tunicate might have the highest possible application potentials in food, cosmetic or pharmaceutical industry due to its valuable compositions of cellulose, glycosaminoglycan (GAG), heparin - like sulfated sugars, fatty acids and sterols etc. Right now, the research focus is on the comparison between woody cellulose and tunicate cellulose and exploring the potential applications of tunicate cellulose are ongoing.



Yadong Zhao
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USE OF MODIFIED CELLULOSE TO REMOVE BACTERIA FROM DRINKING WATER

The goal with my project is to investigate if it is possible to create an easy, lightweight and cheap method to sterilize drinking water using antibacterial fibers. This emergency water treatment technology should be a portable alternative that can be used during the time it takes to install a more sustainable treatment facility. The project aims at removing bacteria from the water by using the modified cellulose(ecofriendly anti-bacterial fibers) to deal with the problems created by bacteria that is the main cause of waterborne diseases.

Anna Ottenhall
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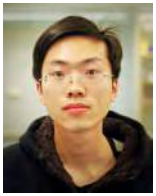
CELLULOSEBASED INSULATION MATERIALS

The objective of my research is to examine properties of some inexpensive cellulosic raw materials such as saw dust, wood shavings etc., as a base for understanding how to – by using a dry manufacturing method – develop cost-effective cellulose based thermal insulation materials. Also the effect of various chemical and physical treatments of the raw materials is to be studied.

Hans Hortans
hortans@kth.se

BIO-BASED INSULATION MATERIALS

My research area involves in developing cellulosic fiber based thermal insulation materials based on forest resources, and the effect of treatment conditions on the properties of final products is also discussed as well. Apart from that, the investigation of bio-based multi-functional fire retardant based on the chemical isolated from forest resources has been underway, and the possibility of this non-toxic flame retardant is being evaluated as well.



Chao Zheng
chaozh@kth.se

INDUSTRIALLY FEASIBLE METHODS FOR PRODUCTION OF NANOCELLULOSE

The overall goal with my project is to develop industrially feasible methods for the production of nanocellulose fibers, methods that do not require the extensive amounts of energy and that does not use expensive or harmful chemicals.Nano-cellulose is, somewhat simplified, normally produced from chemical pulps, using a two step procedure; the pulp is in the first step subjected to a pretreatment which swell and /or weaken the integrity of the cell wall, after which mechanical disintegration is performed releasing the nanofibers from the cell wall.

Carl Moser
cmoser@kth.se

ANTIBACTERIAL FIBERS

My project focuses on surface modification of cellulose fibre by using strong positive charged polyelectrolyte to achieve the antibacterial properties. The layer-by-layer (LbL) technique makes it possible to get an antibacterial function using mild react conditions and water-based solutions. Currently we are using the highly charged cationic chemical polymer polyvinylamine (PVAm) to make contactactive antibacterial fibres, and it could be also interesting to use wood-based polymers as well.

Chao Chen
chaoc@kth.se

FUNCTIONALIZED CELLULOSE BASED TEXTILE FIBERS

My project involves in textile fibers based on renewable resources such as wood or other bio-fibers.In order to explore the potential of a wide range of available bio-based raw materials in textile product, the eco-friendly production process and modifications for the sake of the environment are of importance to be taken into account as well. In addition, the investigation of versatility of final products produced from modified fibers could be advantageous to extend the applications and make a contribution to the sustainable textile industry.

Tianxiao Huang
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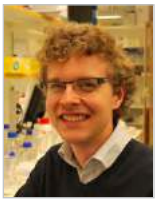
SURFACE-MODIFIED FILMS FOR ADVANCED PACKAGING

The current project aims at building antibacterial LbL layers onto nanocellulosic materials with different structures.By depositing bacterio-static polymers onto surfaces using Layer-by-Layer techniques, it is possible to create antibacterial surfaces at room temperature using only water as solvent.These contact active antibacterial materials offer a safe and eco-friendly way to limit bacterial growth in for example food packaging applications and in the medical area.



Jonatan Henschen
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CHARACTERIZATION AND CHEMICAL MODIFICATION OF TECHNICAL LIGNIN

The goal of our project is to investigate the relationship between the chemical structure of technical lignins, their reactivity in the chemical modification. The membrane filtration technique will be used to fractionate technical lignin. The chemical modification reaction resulting in the lignin with acrylate functionality will be used to study the reactivity of lignin samples and their performance in the different polymeric systems.

Ayumu Tagami
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PULP AND PAPER RESEARCH

As an emeritus professor in this division, I have dedicated myself to pulping and bleaching, wood chemistry and pulp technology for a long period of time. My resaerch fields include the chemical structure of lignin-carbohydrate complex, the properties of high-yield pulps as well as brightness and kappa number variations during the pulping and bleaching precesses.

Göran Gellerstedt
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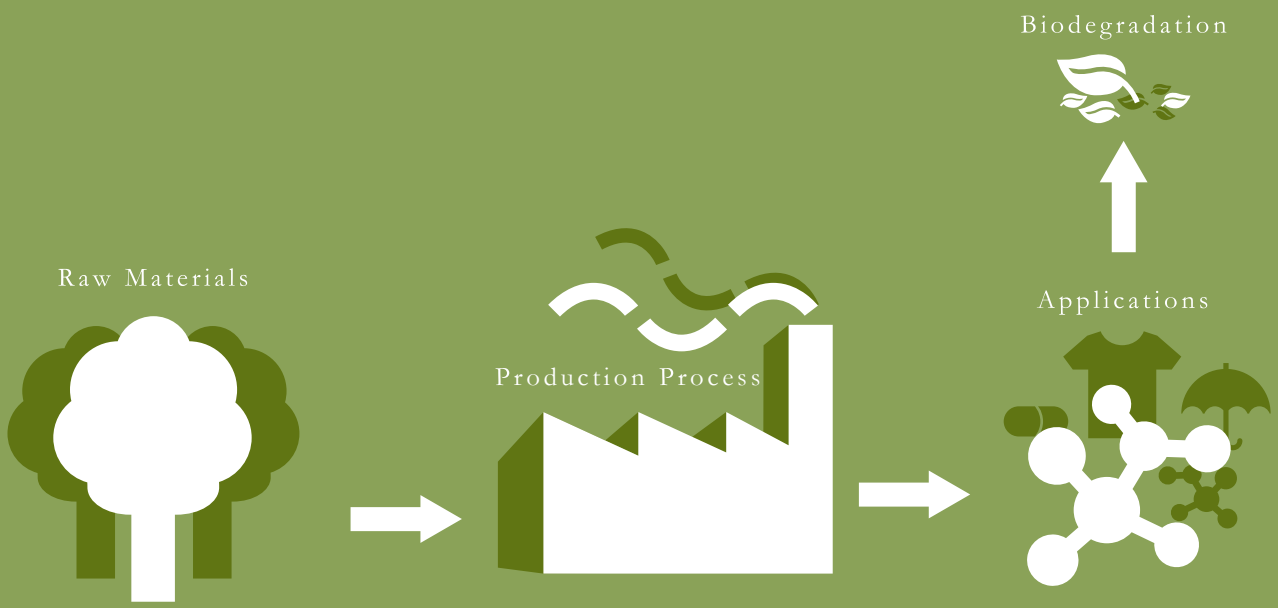
Our research projects deal with the whole life cycle



PUBLICATIONS

2016 Dongfang Li, Rosana Moriana, and Monica Ek. "From forest residues to hydrophobic nanocomposites with high oxygen-barrier properties." Nordic pulp & paper research journal 31.2 : 261-269.

2016 Carl Moser, Gunnar Henriksson, and Mikael E. Lindström. "Specific Surface Area Increase during Cellulose Nanofiber Manufacturing Related to Energy Input." BioResources 11.3: 7124-7132.

2016 Rabinovich, Mikhail L., Olesya Fedoryak, Galina Dobele, Anna Andersone, Barbara Gawdzik, Mikael E. Lindström, and Olena Sevastyanova. "Carbon adsorbents from industrial hydrolysis lignin: The USSR/Eastern European experience and its importance for modern biorefineries." Renewable and Sustainable Energy Reviews 57: 1008-1024.

2016 Yadong Zhao and Jiebing Li, Ascidian bioresources -common and variant chemical compositions and exploitation strategy examples of Halocynthia roretzi, Styela plicata, Ascidia sp and Ciona intestinalis, Zeitschrift für Naturforschung C - A Journal of Biosciences, ISSN: 0939-5075, Vol. 71, No. 5-6, pp. 165-180.

2015 Josefin, Illergård, Lars Wågberg, and Monica Ek. "Contact-active antibacterial multilayers on fibres: a step towards understanding the antibacterial mechanism by increasing the fibre charge." Cellulose 22.3 : 2023-2034.

2015 Dongfang Li, Tommy Iversen, and Monica Ek. "Treatment of a Cellulose Fiber Surface With a Suberin Monomer-Derived Polymer." Polymers from Renewable Resources 6.3: 75.

2015 Rosana Moriana, Francisco Vilaplana, and Monica Ek. "Forest residues as renewable resources for bio-based polymeric materials and bioenergy: chemical composition, structure and thermal properties." Cellulose 22, no. 5: 3409-3423.

2014 Monica Ek, Christine Chirat, Linda Fogelstrom, Tommy Iversen, Dongfang Li, Eva Malmström, Emelie Norström, Herbert Sixta, Lidia Testova, Terhi Toivari och Dariusz Wawro, WOBAMA - wood based materials and fuels, Cellulose Chemistry and Technology, ISSN: 0576-9787, Vol. 48, No. 9-10, pp. 773-779.

2013 Elisabeth Sjöholm, Göran Gellerstedt, Rickard Drougge, and Ida Norberg. "Method for stabilizing lignin fiber for further conversion to carbon fiber." U.S. Patent Application 14/373,887, filed January 21

The last semesters were productive

the upcoming ones will be even better

LJUNGBERGS FONDEN

Ljungberg Foundation

Erik Johan Ljungberg's Education Foundation, known as Ljungberg Foundation, is one of Sweden's largest private foundation for educational projects in engineering, science and entrepreneurship.

"Knowledge is future" is the motto of the foundation, which was created by the founder- Erik Johan Ljungberg over 100 years ago.

Today Ljungberg Foundation supports progressive education that places great emphasis on networking between schools, business and society in the long term.

In 2000, a generous grant from Ljungberg Foundation was awarded our division to edit a series of modern textbooks covering the whole knowledge-chain from tree to paper and converted products.

Order these books,
scan the individual QR codes
1. Biology and Chemistry of Plants.
2. Pulping Chemistry and Technology.
3. Paper Chemistry and Technology.
4. Paper Products Physics and Technology.

Volume 1 Volume 2 Volume 3 Volume 4

Master thesis

2016 Petra Zigher, Aging in Electrotechnical Paper.

The thesis involves in the investigation of the pulps composition influence on vapor phase dried and thermally aged paper from softwood kraft pulp.

2016 Tiinamari Seppänen, Antibacterial materials for water purification.

It focuses on the utilization of antibacterial fibers to create filters for purification of water.

2016 Tianxiao Huang, Hydrophobic Coating on cellulosic textile material by betulin and betulin based Polymer.

The works explored betulin and betulin copolymer to be used to improve the water repellency of textile.

Courses

We are teaching various courses, such as

Bio Fibre Chemistry,
Materials Chemistry and Properties,
Chemistry of a Bio-refinery,
Chemistry for Sustainable Development,
Perspectives on Research and Innovation,
Pulp and Paper Processes.

We would love to hear from you

We are a part of the global /internaltional research cooperation with other universities and industrial partners, participating in national and EU frame work programs, but also bilateral contracts. Long termproject and various chemical analyses of cellulose, hemicellulose, lignin and extractives are conducted. We are also working with education, teaching and writing textbooks and supervising industrial, Master's and PhD students.

CONTACT US TODAY

Please do contact us if you have any questions or interest in any of our projects or if you just want to have a chat. We are located in Stockholm, Sweden at the Royal Institute of Technology.

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Division Wood Chemistry & Pulp Technology

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