

Arvoisa Katalyysiseuran jäsen! Dear member of Catalysis Society!

This year is actually soon ending and it is time to go through main events of this year. It has again been an active year in Finnish and European catalysis the main event being Europacat conference.

Europacat in Florence

13th Europat conference was held in Florence in late August. I was also attending the conference and had pleasure to meet many members of our Finnish society there as well many recognized international scientists of catalysis. Florence as a town is the most beautiful place to have such conference and the weather was nice but maybe too hot for this kind of events. Conference was held at local "palazzo congresso" which I found somewhat too small for Europacat. Conference was also splitted into two separate buildings making transition from a lecture to another sometimes complicated. I found the scientific content of the conference relatively ok but due to complexity of conference program it was sometimes difficult to find topics and lectures you wanted to hear.

Finnish Young Scientist Forum for Catalysis

The main event of this year for our society was 2nd Young Scientist Forum on Catalysis which was held 24th March in Jyväskylä with over 40 participants. Finnish Catalysis Society would like to thank prof. Karoliina Honkala for organizing the event! Catalysis Society decided to continue the tradition and

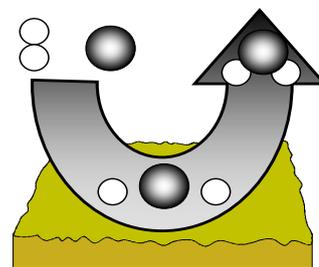
I'm happy to announce that 3rd Finnish Young Scientist Forum for Catalysis will be held 6th April, 2018 in Espoo organized by prof. Riikka Puurunen.

EFCATS

EFCATS (European Federation of Catalysis Societies) is an European umbrella organization of our Finnish Catalysis society. EFCATS organizes e.g. Europacat conferences and gives different awards to recognized scientists. So far, EFCATS has only been an unofficial organization and economy of EFCATS has been taken care by a Dutch foundation. As of 5th October, EFCATS is an official association called AISBL (internationally acting not-for-profit association based on Belgian law and located in Belgium). I hope that this action promotes development of EFCATS as a strong umbrella organization for national catalysis societies in Europe. Prof. Karoliina Honkala and prof. Riikka Puurunen are the current representatives of Finnish Catalysis Society at EFCATS council. Please contact them if you want to hear more about activities of EFCATS.

Finally, I would like to wish you all pleasant autumn!

Juha Lehtonen
Chairman



Greetings from Europacat!

The congress took place in beautiful Florence, Italy on 27-31 August. The theme of the conference was “A bridge to the future” which highlighted “*the crucial role of catalysis science and technology in enabling our sustainable future.*” Five catalyst researchers, namely Yingnan Zhao, Riikka Juhola, Martina Stekrova, Niina Koivikko and Tiina Laitinen, met in Florence, Italy and took part in EuropaCat 2017 conference with the financial support from Finnish Catalysis Society.

The conference presentations were divided into six different topics:

Topic 1: Catalysis to address the evolving energy and chemical scenario

Topic 2: Catalysis for a cleaner and sustainable future

Topic 3: Addressing catalysis complexity

Topic 4: Understanding and design catalyst from molecular to material scale

Topic 5: Expanding catalysis concepts

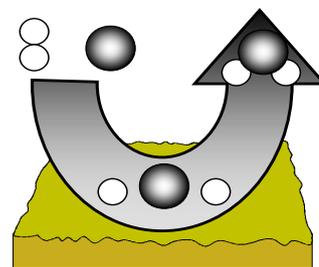
Topic 6: Industrial catalysis



All-star team from Finland: Yingnan Zhao (Aalto University), Riikka Juhola (University of Oulu), Martina Stekrova (Aalto University), Niina Koivikko (University of Oulu) and Tiina Laitinen (University of Oulu).

Katse

Suomen katalyysiseura
Finska katalyssällskapet
Finnish Catalysis Society



JÄSENKIRJE 2/2017

Conference in numbers:

- Over 1700 participants
- 5 plenary lectures
- 22 keynote lectures
- 270 oral lectures
- 30 shot symposia (short lectures á 6 min, over 10 short speeches per section)
- 6 topic for oral sessions
- 900 poster presentations
- Riikka Juhola, *Granulated biomass-based carbon for catalytic water purification*, poster presentation 29.8.2017
- Martina Stekrova, *Aqueous-phase reforming of short-chain alcohols over nickel-based catalysts*, poster presentation 31.8.2017
- Yingnan Zhao, *Carbon oxides on ZrO₂ nanorods*, poster presentation 31.8.2017



Photographer: Riikka Juhola

Contribution of our team:

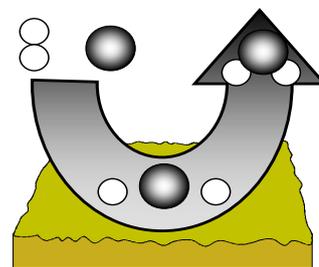
- Tiina Laitinen, *Environmental Applications of Co Catalysts*, oral presentation 31.8.2017
- Niina Koivikko, *V₂O₅/SiO₂-TiO₂ catalyst in SVOC oxidation to formaldehyde: on the role of catalyst composition*, poster presentation 29.8.2017



Tiina Laitinen

Photographer: Niina Koivikko

Katse

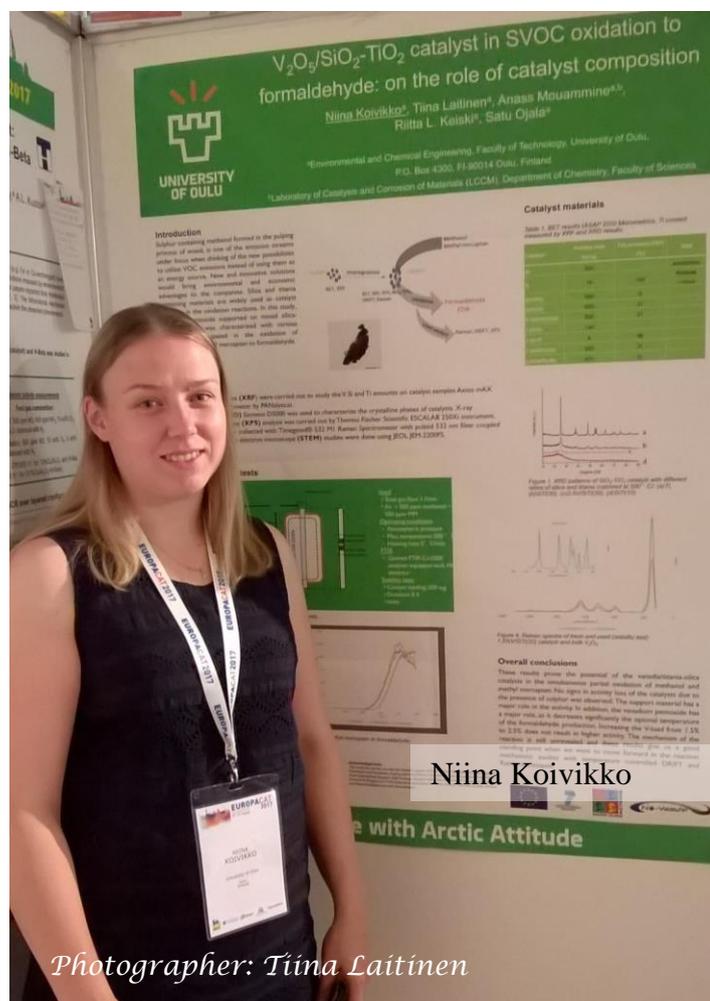


JÄSENKIRJE 2/2017

Suomen katalyysiseura
Finska katalyssällskapet
Finnish Catalysis Society

We were glad to participate the congress to learn the frontier knowledge of interesting scientific topics and exchange ideas on our area of expertise. We paid attention and enjoyed lectures e.g. on hydrogen production from bio-products, advanced catalyst preparation methods, and operando characterization. We got fruitful feedback on our poster presentations/oral presentation from experts of our area, and also many good ideas for our future research.

Photographer: Riikka Juhola



Niina Koivikko

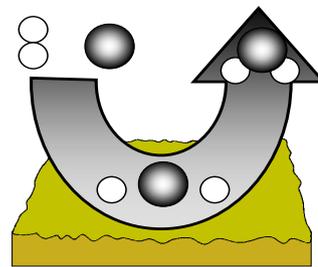
Photographer: Tiina Laitinen

The conference was an excellent chance for us to meet and reconnect with old friends and expand our research network. For some of us this was the first conference to attend, but positive and encouraging atmosphere helped to overcome all the nervousness. During the welcome cocktails, we had fruitful conversations with other researchers, but also we were amused with different kinds of artistic performances. The city of Florence served us also with culture and attraction like Santa Maria del Fiore, biggest cathedral in Florence, and the bridge, Ponte vecchio, that crosses the river Arno. The weather was very hot during the whole week so Italy offered us a good start for the autumn time in Finland.



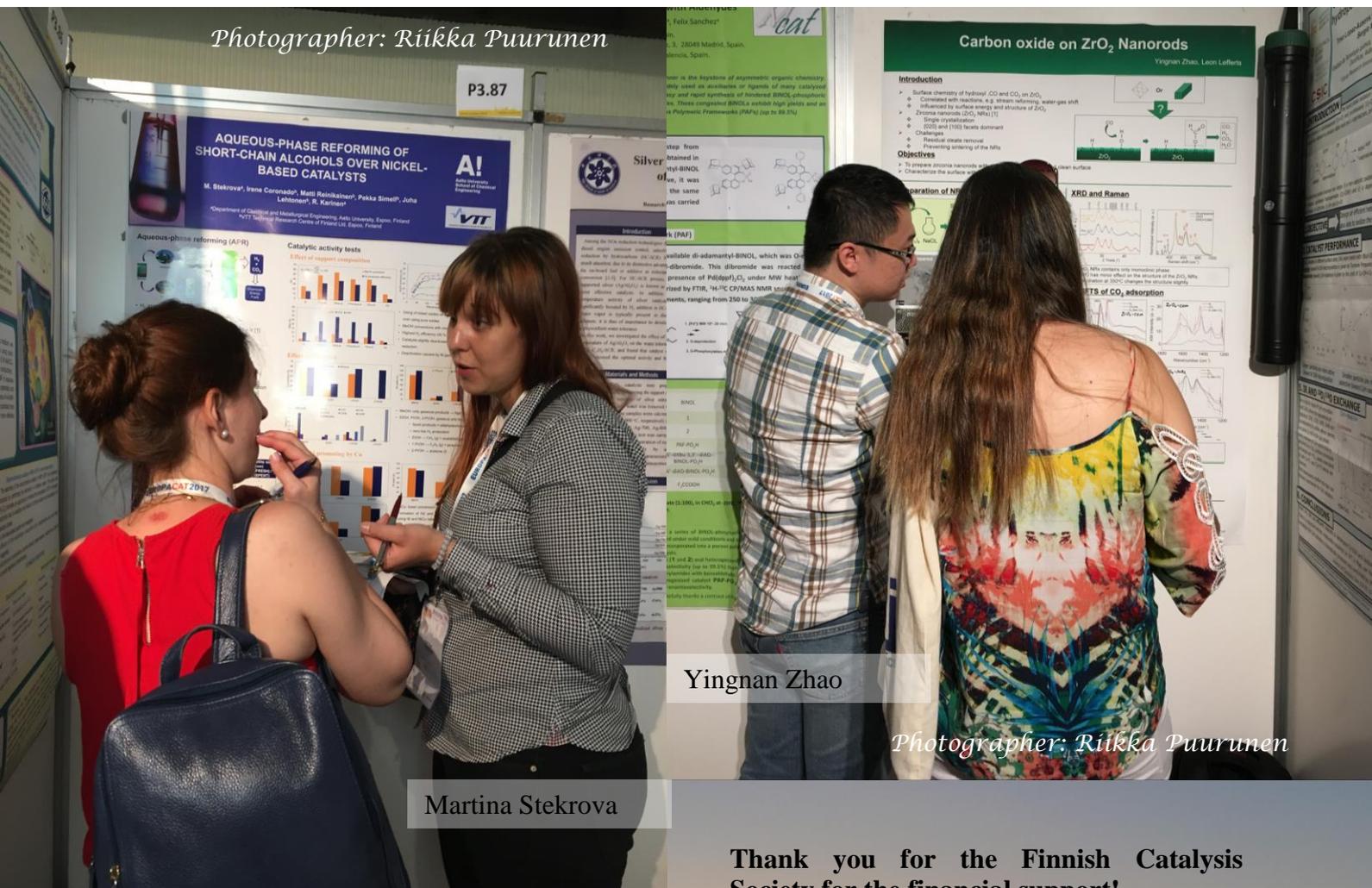
Katse

Suomen katalyysiseura
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JÄSENKIRJE 2/2017

Photographer: Riikka Puurunen



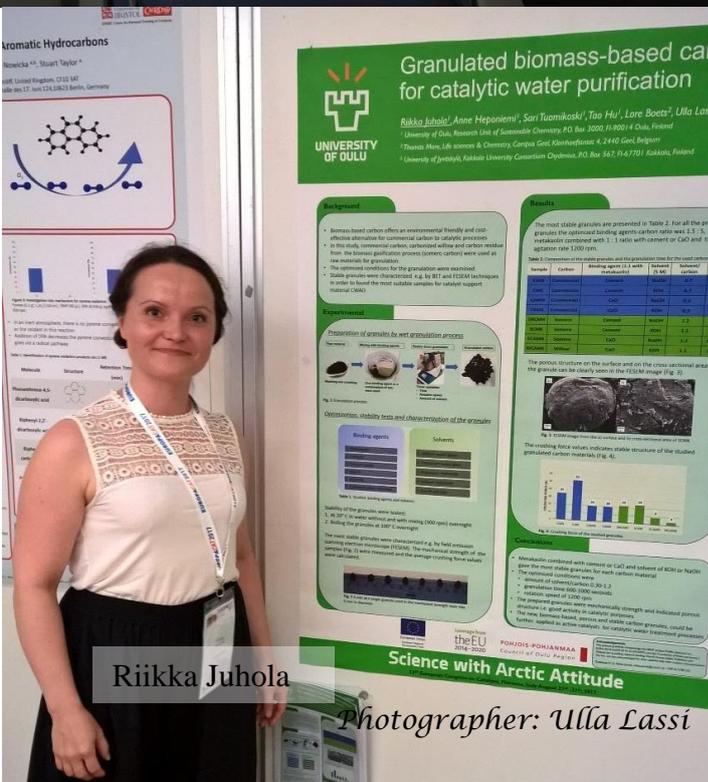
Yingnan Zhao

Photographer: Riikka Puurunen

Martina Stekrova

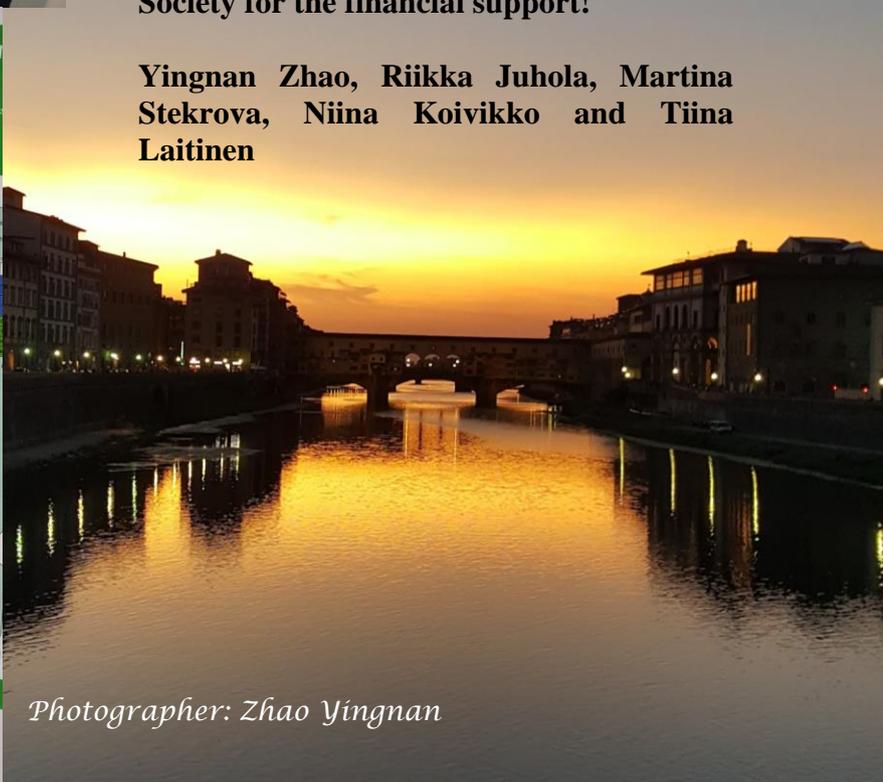
Thank you for the Finnish Catalysis Society for the financial support!

Yingnan Zhao, Riikka Juhola, Martina Stekrova, Niina Koivikko and Tiina Laitinen

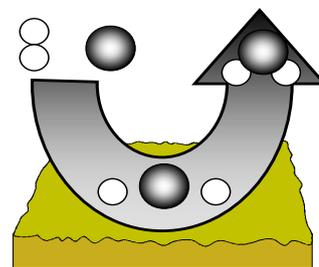


Riikka Juhola

Photographer: Ulla Lassi



Photographer: Zhao Yingnan



EFCATS Council meeting at EuropaCat

Prof. Karoliina Honkala and Prof. Riikka Puurunen attended, as representatives of Finland selected by the Finnish Catalysis Society, the EFCATS Council meeting organized along with the EuropaCat2017 conference in Firenze.

In the meeting, Prof Bert Weckhuysen was voted as the President of EFCATS for the next two years. Other members of the Office were selected as listed in:

<http://efcats.org/officers.html>.

The status of activities to change the status of EFCATS to a Belgian AISBL (not-for-profit organization) was presented.

The next EuropaCat conference in Aachen in 2019 <http://europacat2019.eu/> “Catalysis without borders” was introduced.

In 2018, EFCATS summer school will be organized in Czech Republic, for more information, see <http://www.jh-inst.cas.cz/efcats.school/>.

New Professor at Aalto University

Prof. Yongdan Li has started in June 2017 as full professor of Industrial Chemistry at Aalto University School of Chemical Engineering, Department of Chemical and Metallurgical engineering. Yongdan Li moved to Aalto University from Tianjin University, China, where has built a decades-long career as professor of Industrial Catalysis.

Young Scientist Forum 2018

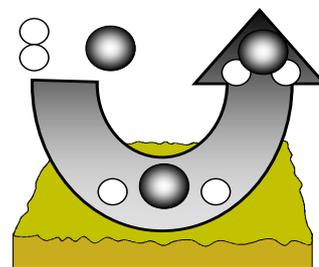
The 3rd Finnish Young Scientist Forum on Catalysis will be organized on 6th of April, 2018, somewhere close to Helsinki. The organizer of the event is Prof. Riikka Puurunen and the group.

Watch for more info to come at the website of the Finnish Catalysis Society <http://www.katalyysiseura.org/> and at the Aalto IndChemCat website: http://cmet.aalto.fi/en/research/industrial_chemistry_catalysis/young_scientist_forum_2018/.

Twitter hashtag of the event: [#YSFC2018](https://twitter.com/YSFC2018). Follow also: [#FinCatSoc](https://twitter.com/FinCatSoc), for Finnish Catalysis Society.



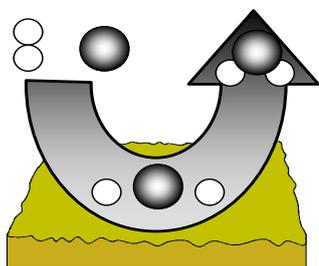
Photographer: Helena Seppälä



Suunnittele katalyysiseuralle uusi logo! / Design a new logo for the Finnish catalysis society

Finnish Catalysis Society is having a logo competition!

The new logo will replace our well-served logo e.g., on the website and in Katse. The new logo needs to be original and describe catalysis, but otherwise participants will have free hands. **The contest is open to all friends of catalysis independent of experience and knowledge of catalysis and design.** Each participant may submit one entry digitally to karoliina.honkala at jyu.fi before February 15th 2018. The board of Finnish Catalysis Society will select the winning logo. The winner will be announced in the next Young Scientist Forum in Espoo, where he/she will be invited (free of charge). The name of the winner will be published in Katse and on the website of the Finnish Catalysis Society.



Catalysis related dissertations in 2017

M.Sc. (Chem) Laura Schneider from the Faculty of Technology, Research unit of Sustainable Chemistry, University of Oulu, defended her thesis on 11th of October, 2017 in Kokkola University Consortium Chydenius. Her thesis was entitled

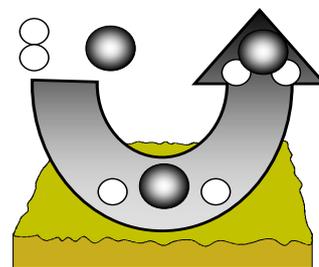
”Mechanocatalytic pretreatment of lignocellulosic barley straw to reducing sugars”.

Opponent: docent Päivi Mäki-Arvela, Åbo Akademi, Finland,

Custodian: Prof. Ulla Lassi

Abstract:

Biomass conversion methods represent bioeconomic solutions for the sustainable production of value added commodities (chemicals and materials) as well as for energy purposes, either in solid (pellets), liquid (transport fuels) or gaseous (combustion gases e.g. biomethane) form. Lignocellulosic biomass as a renewable source available in immense quantity, is considered to be one of the most promising natural sources, with high potential in the replacement of conventional transportation fuels and reduction of greenhouse gas emission. This thesis provides new insights into mechanocatalysis, which as yet is a novel technique in biomass catalytic conversion. The mechanocatalytic approach combines chemical catalysis and mechanical assisted processing driven by ball milling. Lignocellulosic barley straw was impregnated or merely mixed with the catalyst (formic acid, acetic acid, sulfuric acid, oxalic acid dihydrate and potassium pyrosulfate) and ball milled under various conditions yielding the selective depolymerization of lignocellulose into water-soluble xylo-oligosaccharides. Subsequent hydrolysis at moderate temperatures resulted in the formation of valuable reducing sugars, mainly xylose, galactose, arabinose and glucose, which constitute the basic materials for transportation fuel and chemical production.



Reducing sugar release of 53.4 wt% with low by-product formation was observed within short milling durations using sulfuric acid as a catalyst in mechanocatalysis. Likewise, oxalic acid dihydrate and potassium pyrosulfate as a novel catalyst, successfully converted barley straw to reducing sugars (42.4 wt% and 39.7 wt%, respectively), however longer milling durations were required. In comparison, lower saccharification (<10 wt%) was obtained by employing formic acid and acetic acid in mechanocatalysis. Harsh milling conditions initiated a temperature increase within the reaction vessel resulting in enhanced sugar release. Likewise, greater sugar release was observed with increased catalyst amount and acidity. The results revealed that the balance of these factors is crucial for efficient catalytic conversion of barley straw.

M.Sc. (Eng.) Yue Dong from the Faculty of Technology, Research unit of Sustainable Chemistry, University of Oulu, will defend her thesis on 8th of November, 2017 in Kokkola University Consortium Chydenius. Her thesis entitled

”Catalytic depolymerisation of lignocellulosic biomass into reducing sugars: Use of ionic liquids and acid-catalysed mechanical approach”.

Opponent: Dr. Mihkel Koel, Tallinn University of Technology, Estonia,

Custodian: Prof. Ulla Lassi

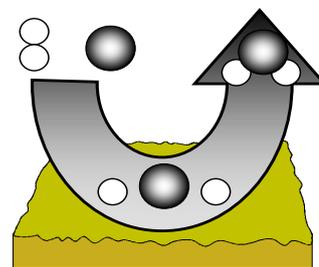
Abstract:

Lignocellulosic biomass is the most abundant renewable raw resource on the earth and it is so far the most suitable and promising

resource for the production of biofuels to replace long-term used fossil oil. This research aims to convert lignocellulose-based industrial residuals, fibre sludge (FS) from pulp mill and pine sawdust (PSD) from sawmill, into platform sugars by two different dual-functionalized pretreatments of lignocellulosic biomass. The dual-functionalized pretreatment combined the ordinary pretreatment (deconstruction) of lignocellulosic biomass and lignocellulosic polysaccharides saccharification. The outcome from both pretreatments can be further transformed into biofuels and chemicals.

PSD and FS were converted into platform sugars by acid-catalysed mechanical depolymerisation in a planetary ball mill in the first part of this research. The efficiency of the conversion was mainly affected by the transferred energy caused by collisions, the total milling time, acid concentration and moisture content in the reaction. Approximately 30 wt% of the sugars was yielded in a 30 min milling process with an acid/substrate (A/S) concentration of 0.45 mol kg⁻¹ without any prior treatment.

The second part of this research delicates the conversion of FS into platform sugars using hydroxyalkylimidazolium hydrogensulphate ionic liquids (ILs). Around 29 wt% of the sugars was produced from FS using an IL/water mixture. The added water acted as co-solvent and played a critical role in utilisation of these ILs. The blended water reduced the viscosity of the ILs and enhanced the mass transfer between solvent and solute. In addition, the anions of the ILs provided their acidic property in aqueous solution and offered an acidic environment for hydrolysis simultaneously.



M.Sc. Tiia Viinikainen from the Aalto University defended in 13.3.2017. The title of her thesis was

“Characterization of zirconia-based gasification gas clean-up catalysts”

Opponent: Prof. Louise Olsson, Chalmers University of Technology, Sweden

Custodian: Prof. Jukka Seppälä, Aalto University, School of Chemical Technology and BIT Research Centre, Finland

Abstract:

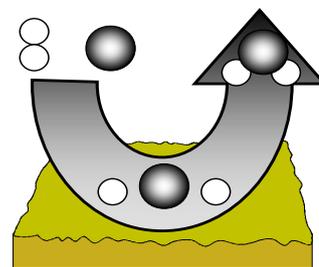
Characterization of catalysts is an expanding field of catalysis and new techniques are adapted more and more from other disciplines of science. Catalyst characterization should answer at least to the following questions: 1) which properties of the catalyst correlate well with its activity, 2) what are the key intermediates and how they are adsorbed on the catalyst, 3) what kind of surface sites are involved, and 4) which is the mechanism for the studied reaction.

In this thesis, zirconia-based catalysts were studied. Catalytic applications of zirconia often takes advantage of its acidic and basic surface properties although their strength is relatively weak. The catalytic properties and thermal stability of zirconia can be further enhanced by the addition of dopants. ZrO₂ has been reported to be sulfur and water tolerant. These unique characteristics have led to study zirconia-based catalysts in gasification gas cleaning applications.

Gasification of biomass is one potential and environmental benign way to produce energy, liquid biofuels and chemicals. Gasification is a thermo-chemical process where biomass is converted to gaseous products. The main

components of gasification gas are carbon monoxide, hydrogen and carbon dioxide. Gas also contains impurities, such as ammonia and tar, and the gas has to be cleaned before use. Zirconia-based catalysts have shown to selectively oxidize tar molecules during hot gas cleaning at 600-900 °C when a small amount of oxygen is added into the gas. The catalysts selected for this thesis were ZrO₂, Y₂O₃-doped ZrO₂ and SiO₂-doped ZrO₂.

The activity of the catalysts in gasification gas cleaning decreased in the order of ZrO₂ > Y₂O₃-ZrO₂ > SiO₂-ZrO₂. Relating the acidity and basicity of the catalysts to their activity suggested that acidity is not a desirable characteristic for gasification gas clean-up catalysts whereas basicity seems to be useful. Four types of toluene-derived surface species were discovered: molecularly adsorbed toluene, surface benzoate species, carbonaceous deposits and benzyl species, the latter being the key intermediate in toluene oxidation. Over all the catalysts, toluene was completely converted at temperatures above 550 °C to carbon dioxide, water, carbon monoxide and hydrogen. Of the main gasification gas components, water was shown to inhibit toluene oxidation activity over all these catalysts; the most over SiO₂-ZrO₂ and the least over pure ZrO₂. The preferentiality, i.e. ability of the catalysts to protect the valuable gas components while oxidizing toluene, was addressed. The highest preferentiality of toluene over both CO and H₂ was observed over pure ZrO₂ at higher temperatures. Thus, pure ZrO₂ was proven to manifest exceptional performance in preferential toluene oxidation. However, the tar oxidation activity of pure ZrO₂ could be further improved and the gasification process could be further optimized in order to compete with fossil fuel based applications.



M.Sc. Noora Kaisalo from Aalto University defended in 18.8.2017. The title of her thesis was

“Tar reforming in biomass gasification gas cleaning”

Opponent: Dr. Tilman Schildhauer, Paul Scherrer Institute, Switzerland

Custodian: Puurunen, Riikka, Prof., Aalto University, Department of Chemical and Metallurgical Engineering, Finland

Abstract:

Thermochemical conversion of biomass can be used to produce synthesis gas via gasification. This synthesis gas can be further upgraded to renewable fuels and chemicals provided that the gas is ultra clean. To achieve this, impurities, such as light hydrocarbons and tar compounds present in the gasification gas can be converted to syngas by reforming.

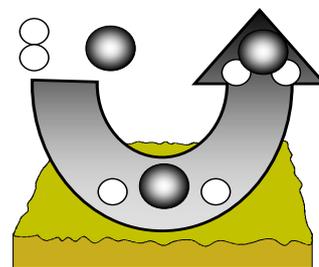
The amount of tar in gasification gas can be reduced already in the gasifier by using catalytically active bed materials. Typical bed materials in fluidized bed gasification are sand, olivine, dolomite and MgO. The tar conversion activity of dolomite and MgO were found to be high at atmospheric pressure. However, the activity was lost when the pressure was increased to 10 bar.

Gasification gas contains, in addition to tar, ethene, which may contribute to further tar formation in high temperature zones of the process, especially at elevated pressures. Ethene forms tar compounds by radical chain reactions. The tar formed by thermal reactions of ethene resembles the tar from

high temperature fluidized bed gasification, which contains mainly secondary and tertiary tar compounds.

Carbon formation on the reformer catalysts presents a challenge in biomass gasification gas cleaning. The presence of sulfur in the gas, mainly in the form of H₂S, also complicates reforming. Typical catalysts used in the reformer after the gasifier are precious metal and nickel catalysts. The heat for reforming can be brought either indirectly in the case of steam reforming or by adding oxygen to the feed for autothermal reforming. Nickel and precious metal catalyst activities were analysed in experiments of around 500 hours with several different gas compositions. Catalyst deactivation was higher with steam than autothermal reforming. The use of catalytically active bed materials to reduce tar concentration already in the gasifier is especially favourable for steam reforming as the catalyst deactivation rate was decreased by the lower hydrocarbon content of the gas.

Benzene, a highly stable compound, is a typical residual compound in the gas after the reformer. Thus, the reformer could be designed based on the reforming kinetics of benzene, for example in the production of synthetic natural gas. For this purpose, qualitative analysis of the effect of the main gasification gas compounds (H₂, CO, CO₂, H₂O) on reforming kinetics were studied with a nickel catalyst. Benzene reforming can be described by first order kinetics if the parameters are estimated for the specific gas composition.



M.Sc. Vincenzo Russo from Åbo Akademi University defended in 13.10.2017. The title of her thesis was

“Reactor Modelling for Fluid-Solid Systems”

Opponent: Prof. Evgeny Rebrov, University of Warwick, UK

Custodian: Prof. Tapio Salmi, Åbo Akademi

Abstract

The aim of the present doctoral thesis is the development of reliable mathematical models for the simulation of fluid-solid reactors. The main idea was to elaborate a rigorous general non-isothermal three-phase tubular reactor model. The evolution of both concentration and temperature profiles was along all the four coordinates constituting the reactor itself, i.e.: (i) reactor length, (ii) reactor radius, (iii) radius of each particle located inside each position of the reactor, (iv) time. The model was developed to be switchable, giving the possibility to derive submodels by setting some parameters at zero.

Different sub-models were tested on real case studies, and good results in terms of data interpretation were obtained. Each chapter of this thesis is dedicated to the presentation of a model/sub-model with a related application to a practical case study. The general model was applied to an exothermic three-phase reaction performed in a laboratory-scale trickle bed reactor. The simultaneous solution of both mass and heat balances was described in detail. The tested sub-models were either twophase or single-phase models. In particular, two microreactor models were developed for the partial oxidation of ethylene, and a two-phase packed bed reactor for the partial oxidation of ethanol.

The final chapter describes the results of a special liquid-solid system, where the solid acts as a reactant and diminishes in size as the reaction progresses. The reaction was considered to proceed simultaneously both in the stagnant film surrounding the solid particle and in the bulk phase of the liquid. As the reaction proceeds, the particle radius shrinks and the stagnant film becomes thinner. An approach was presented for a development of a shrinking particle model, where the problem of the moving boundary was successfully solved. The model was applied to a real case that is the limestone dissolution, obtaining good results.

The developed models will be the basis for future application on both laboratory and industrial scale reactors.

M.Sc. María Pinilla de Dios from Åbo Akademi University defended in 15.3.2017. The title of her thesis was

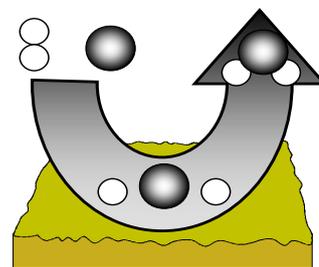
“Heterogeneous Catalytic Copolymerization Reactions of Carbon dioxide and Propylene oxide over Polyalcohols Under Subcritical Conditions”

Opponent: Prof. Rafael Luque Álvarez de Sotomayor, Universidad de Còrdoba, Spain

Custodian: prof. Tapio Salmi, Åbo Akademi

Abstract:

Carbon dioxide (CO₂) is one of the main gases which cause the greenhouse effect. As a way to attenuate this damage, CO₂ could be used as a building block for copolymerization reactions; precisely as C1 feedstock (monomer of the reaction) and as the pressurizing gas in these copolymerization reactions. The required monomer which is



involved in the reactions is propylene oxide (PO) which possesses a high reactivity, enabling the CO₂ bonding. Through the mechanism of ring opening polymerization (ROP), the incorporation of CO₂ in the polymer chain can be possible. During this research, two different heterogeneous catalysts were used for the copolymerization reactions. Zinc glutarate (ZnGA) and double metal cyanide (DMC) were selected as plausible catalysts to perform the reactions.

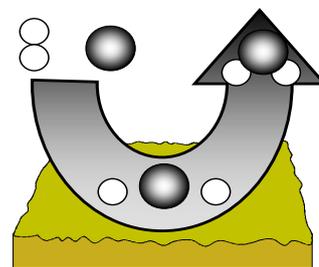
The goal of this doctoral thesis is to study these heterogeneous catalysts in copolymerization reactions between PO and CO₂ to understand how the catalyst and the process can be improved for a possible future industrial application.

To characterize the catalysts, several techniques were used such as Fourier transform infrared spectroscopy (FTIR and FTIR with pyridine), inductively coupled plasma optical emission spectroscopy (ICP), light scattering (with air and distilled water), nitrogen physisorption, scanning electron microscopy and energy-dispersive X-ray spectroscopy (SEM-EDX), thermogravimetric analysis-mass spectrometry (TGA-MS), X-ray photoelectron spectroscopy (XPS) and X-ray powder diffraction (XRPD). The goal of these copolymerization reactions was to obtain a liquid CO₂/propylene oxide copolymer, understanding the formation of carbonate bonds (polypropylene carbonate, PPC) and trying to minimize the cyclic propylene carbonate production (by-product, PC).

Fourier transformed infrared spectroscopy (FTIR), nuclear magnetic resonance (NMR) and size exclusion chromatography (SEC) techniques were used to analyse the copolymers obtained from these reactions. The first catalyst used for the study was zinc

glutarate (ZnGA), as it is shown in **Chapter 1**. An exhaustive characterization of this heterogeneous catalyst was carried out with a complete study of its behaviour in copolymerization reactions. This catalyst was synthesized by mixing zinc oxide, glutaric acid and toluene. ZnGA proved to be a catalyst without any porosity and without Brønsted and/or Lewis acid sites. The active area was the outer surface area of the catalyst, where the Zn²⁺ active sites exist. In this catalyst, the average amount of Zn²⁺ amount was around 353 mg Zn / g catalyst. The sample was very disperse on particle sizes, showing also a rectangular plate shape morphology with an average size of 321.6 nm. Several different reaction conditions were screened for the formation of the copolymers from propylene oxide (PO), carbon dioxide (CO₂) and polypropylene glycol (as initiator, PPG of 425 g/mol). The study included changes in the amount of ZnGA (0.3, 0.6, 1.0, 1.5 g), reaction temperature (60, 80 °C), reaction pressure (6, 25 barg), final expected molecular weight of the copolymer (725, 3000 g/mol) and the reaction time (20, 40 h). Finally, it was possible to conclude that the best conditions corresponded to 1.5 g of catalyst, 25 barg, 80 °C, 40 h and 3000 Da of initial PO estimation. TON (Turnover number) and TOF (Turnover frequency) values are really low which demonstrated the low activity of this catalyst. A completely different behavior was observed when a double metal cyanide catalyst (DMC) was used.

In **Chapters 2** and **3** several DMC catalysts were synthesized and characterized in order to determine which one is the most active. **Chapter 2** showed the effect of varying the initial amounts of zinc chloride (ZnCl₂) on the catalytic activity, in order to determine the influence of the catalyst preparation method.



Five different DMC catalysts were synthesized from zinc chloride (ZnCl_2), potassium hexacyanocobaltate (III) ($\text{K}_3[\text{Co}(\text{CN})_6]_2$), tert-butanol (tBuOH, as complexing agent (CA)) and polyethylene glycol 1000 (PEG 1000, as co-complexing agent (co-CA)). The Zn/Co ratio was changed during the synthesis, having one reagent always in excess to reveal its impact on the catalytic activity, crystallinity and other properties. The presence of K^+ caused a dramatic decrease on the catalyst activity, while an increase of Zn^{2+} produced more agglomerations of spherical particles in the catalyst (DMC E). Only two of the catalysts prepared were successfully activated (D and E catalysts, according to the nomenclature used in this thesis). Their morphologies were lamellar with spherical particle agglomerations. After the copolymerization reactions, all the copolymers were analysed revealing that the most active catalyst was DMC E. With DMC E it was possible to achieve a high catalytic activity (2.5 kg polymer / g catalyst) with an increased CO_2 incorporation (6.7 %) and a lower production of the cyclic propylene carbonate, PC (0.3 %). The implementation of mechanical stirrer instead of the initial magnetic one, decreased the polydispersity index (PDI) values from 5.97 and 13.09 to values around 1 to 1.1. The results showed that it is possible to obtain shorter dispersed copolymer chains in the bulk reaction medium.

Chapter 3 was focused on the catalyst activation stage previous to the copolymerization reaction process. This catalyst was named as DMC A and it was exactly the same as the DMC E discussed in **Chapter 2**. This catalyst had only 0.0002 mol/ g cat of K^+ while the amount of Zn was 0.0036 mol/ g catalyst. 12 experiments were carried out for this DMC catalyst activation study,

modifying the amount of catalyst using 10, 20, 40 and 80 mg of DMC and 4, 8 and 18 g of propylene oxide in total. This kind of catalyst is not a selective one and, after the reaction, high concentrations of the by-product were obtained. As the amount of DMC was increased, the PC amount also increased with the same CO_2 incorporation in the final copolymer. Using only 20 mg of catalyst per batch, the reaction produced more polypropylene carbonate (PPC) and cyclic propylene carbonate (PC) with the highest values of TON and TOF and the lowest PDI value. These results were confirmed by the FTIR spectrum for 20 mg of DMC A catalyst. Apart from these chapters, the current PhD thesis has also an appendix. The appendix shows the solubility of CO_2 in different polycarbonates. Several experiments at different temperatures, trying to charge the same initial pressure, were conducted to determine how the solubility is influenced by temperature and pressure.

Conferences and symposia

Kokkola Material Week 2017

28.10.-3.11.2017, Kokkola

Kokkola Material Week on vuosittainen tapahtuma, jossa tuodaan monipuolisesti esiin alueen kemianteollisuuden, biotalouden ja kiertotalouden näkymiä sekä siihen liittyvää tutkimus- ja kehitystyötä.

Ohjelma ja ilmoittautuminen:

www.materialweek.fi

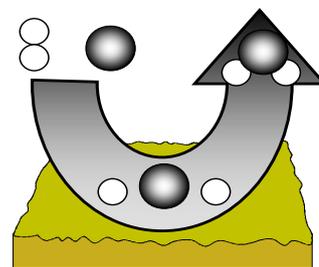
4th International Congress on Catalysis for Biorefineries, Catbior 2017

December 11-15, Lyon, France

<http://catbior2017.univ-lyon1.fr/en>

Katse

Suomen katalyysiseura
Finska katalyysällskapet
Finnish Catalysis Society



JÄSENKIRJE 2/2017

Web pages

EFCATS School on Catalysis, June 25-29, 2018, Liblice Castle in Czech Republic
<http://www.jh-inst.cas.cz/efcats.school/>

3rd Fundamentals and applications of cerium dioxide in catalysis, June 25-28, 2018, Barcelona, Spain.
<https://ceria2018.upc.edu/en>

CARBOCAT VIII, June 26-29, 2018, Porto, Portugal.
<http://carbocatviii.eventos.chemistry.pt/>

Gold 2018, July 15-18, 2018, Paris, France
<http://www.gold2018.org/>

18th Nordic Symposium on Catalysis, Copenhagen, August 26-28, 2018.

Abstract deadline 1st April, 2018.

<http://www.conferencemanager.dk/NSC2018>

14th EuropaCat – European Congress on Catalysis “Catalysis without borders”
August, 18-23, 2019, Aachen Germany
www.europacat2019.eu

See also e.g.

www.conference-service.com

www.iacs-icc.org/Events/events.html

<http://www.katalyysiseura.org>

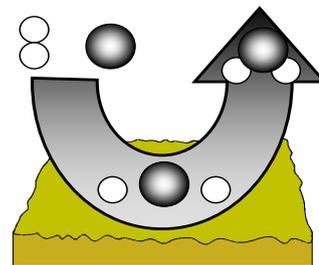
<http://www.kemianseura.fi>

<http://www.efcats.org>

<http://www.elsevier.com>

Katalyysiseuran hallitus toivoo, että saisimme palautetta jäsenkunnaltamme Katse-lehdestämme ja uutisia julkaistavaksi kuten väitökset, kansalliset ja kansainväliset tapahtumat, palkinnot, kurssit yms. Palautteet ja uutiset voi toimittaa hallituksen jäsenille.

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Tutkimusprofessori Juha Lehtonen
Teknologian tutkimuskeskus VTT Oy
PL 1000, 02044 VTT
puh. +358 504071075
etunimi.sukunimi at vtt.fi

Varapuheenjohtaja/Vice-Chair

Prof. Karoliina Honkala
Kemian laitos, nanotiedekeskus
PL 35, 40014 Jyväskylän yliopisto
puh. +358 (0)40-8053686
etunimi.sukunimi at jyu.fi

Sihtööri/Secretary

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Oulun yliopisto/Teknillinen tiedekunta/Ympäristö- ja
kemiantekniikka,
PL 4300, 90014 OULUN YLIOPISTO
puh. +358(0)50 350 6098
etunimi.sukunimi at oulu.fi

Varainhoitaja/Treasurer

Salla Jaatinen
Neste Oyj, Research and Development
PL 310, 06101 Porvoo
puh: +358 50 458 7461
etunimi.sukunimi at neste.com

Muut jäsenet/Members of the board

Prof. Riikka Puurunen
Aalto-yliopisto
Kemian tekniikan korkeakoulu
PL 16100
00076 AALTO
puh. +358 50 3378161
etunimi.sukunimi at aalto.fi

Assoc. Prof. Henrik Grénman
Åbo Akademi/Molekylär process- och
materialteknik/Teknisk kemi och
reaktionsteknik, Processkemiska centret Biskopsgatan
8, FI-20500 Åbo
+358 2 215 4574
förnamn.efternamn at abo.fi

Varajäsenet/Alternate members

TkT Teuvo Maunula
Dinex-Ecocat Oy
Global Catalyst Competence Center
PL 20
FI-41331 Vihtavuori, Finland
tel. +358 505866200
tma at dinex.fi

FT Anne Heponiemi
Oulun yliopisto/Teknillinen tiedekunta/Soveltava
kemia
PL 3000, 90014 OULUN YLIOPISTO
puh. +358 505715560