The Effect of Pt Particle Size on the Oxidation of CO, C3H6, and NO Over Pt/Al2O3 for Diesel Exhaust Aftertreatment

Platinum-based oxidation catalysts applied for diesel exhaust aftertreatment constitute a significant part of system costs. Effective utilization of platinum is therefore relevant to reduce costs while retaining performance. To this end, the influence of Pt particle size on catalytic activity for CO, hydrocarbon, and NO oxidation was studied. 1 wt% Pt/Al2O3 catalysts were prepared by wet impregnation, drying, and different calcination and thermal treatments, yielding Pt particles with diameters between 1.3 and 18.7 nm, as determined by CO pulse titration and transmission electron microscopy. Activity measurements for CO, C3H6, and NO oxidation showed an optimal Pt particle size with respect to the mass based activity between 2 and 4 nm for all three reactions. From measured turnover frequencies and site statistics of Pt particles, the reactions appear to be mainly catalyzed by terrace atoms, which are most abundant between 2 and 4 nm. The decrease in catalytic activity for large Pt particles is therefore due to the diminishing Pt surface area, while the decrease in activity for small particles is due to the lack of terrace atoms required for CO, HC, and NO oxidation.
H2CAP - Hydrogen assisted catalytic biomass pyrolysis for green fuels

General information
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Organisations: Department of Chemical and Biochemical Engineering, CHEC Research Centre, Haldor Topsoe AS
Authors: Stummann, M. Z. (Intern), Høj, M. (Intern), Gabrielsen, J. (Ekstern), Jensen, P. A. (Intern), Jensen, A. D. (Intern)
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Bismuth molybdate catalysts prepared by mild hydrothermal synthesis: Influence of pH on the selective oxidation of propylene

A series of bismuth molybdate catalysts with relatively high surface area was prepared via mild hydrothermal synthesis. Variation of the pH value and Bi/Mo ratio during the synthesis allowed tuning of the crystalline Bi-Mo oxide phases, as determined by X-ray diffraction (XRD) and Raman spectroscopy. The pH value during synthesis had a strong influence on the catalytic performance. Synthesis using a Bi/Mo ratio of 1/1 at pH ≥ 6 resulted in γ-Bi2MoO6, which exhibited a better catalytic performance than phase mixtures obtained at lower pH values. However, a significantly lower catalytic activity was observed at pH = 9 due to the low specific surface area. γ-Bi2MoO6 synthesized with Bi/Mo = 1/1 at pH = 6 and 7 exhibited relatively high surface areas and the best catalytic performance. All samples prepared with Bi/Mo = 1/1, except samples synthesized at pH = 1 and 9, showed better catalytic performance than samples synthesized with Bi/Mo = 2/3 at pH = 4 and 9 and γ-Bi2MoO6 synthesized by co-precipitation at pH = 7. At temperatures above 440 °C, the catalytic activity of the hydrothermally synthesized bismuth molybdates started to decrease due to sintering and loss of surface area. These results support that a combination of the required bismuth molybdate phase and a high specific surface area is crucial for a good performance in the selective oxidation of propylene.
Systematic study on the influence of the morphology of α-MoO3 in the selective oxidation of propylene

A variety of morphologically different α-MoO3 samples were prepared by hydrothermal synthesis and applied in the selective oxidation of propylene. Their catalytic performance was compared to α-MoO3 prepared by flame spray pyrolysis (FSP) and a classical synthesis route. Hydrothermal synthesis from ammonium heptamolybdate (AHM) and nitric acid at pH 1-2 led to ammonium containing molybdenum oxide phases that were completely transformed into α-MoO3 after calcination at 550 °C. A one-step synthesis of α-MoO3 rods was possible starting from MoO3·2H2O with acetic acid or nitric acid and from AHM with nitric acid at 180°C. Particularly, if nitric acid was used during synthesis, the rod-like morphology of the samples could be stabilized during calcination at 550°C and the following catalytic activity tests, which was beneficial for the catalytic performance in propylene oxidation. Characterization studies using X-ray diffraction (XRD), scanning electron microscopy (SEM) and Raman spectroscopy showed that those samples, which retained their rod-like morphology during the activity tests, yielded the highest propylene conversion.
Pyrolysis of biomass produces a high yield of condensable oil at moderate temperature and low pressure. This bio-oil has adverse properties such as high oxygen and water contents, high acidity and immiscibility with fossil hydrocarbons. Catalytic hydrodeoxygenation (HDO) is a promising technology that can be used to upgrade the crude bio-oil to fuel-grade oil. The development of the HDO process is challenged by rapid catalyst deactivation, instability of the pyrolysis oil, poorly investigated reaction conditions and a high complexity and variability of the input oil composition. However, continuous catalytic hydropyrolysis coupled with downstream HDO of the pyrolysis vapors before condensation shows promise (Figure 1). A bench scale experimental setup will be constructed for the continuous conversion of solid biomass (100g/h) to low oxygen, fuel-grade bio-oil. The aim is to provide a proof-of-concept for the proposed process (Figure 1), to understand the reaction mechanisms of HDO, to develop highly active and durable catalysts for hydropyrolysis and HDO and to optimize the operating conditions; all in order to develop a sustainable production of green transportation fuels from biomass. To support the process development, the conversion of different bio-oil model compounds over a widerange of...
catalyst classes (reduced types, oxides, phosphides and sulfides) will be investigated. Special attention will be paid to operating conditions (e.g. temperature, \(H_2\) partial pressure, residence time) and toleration against water, sulfur, chlorine and potassium which are abundant in bio-oil.

**General information**

**State:** Published

**Organisations:** Department of Chemical and Biochemical Engineering, CHEC Research Centre, Department of Mechanical Engineering, Thermal Energy, Stanford University, Haldor Topsoe AS, Karlsruhe Institute of Technology

**Authors:** Arndal, T. M. H. (Intern), Høj, M. (Intern), Jensen, P. A. (Intern), Jensen, A. D. (Intern), Clausen, L. R. (Intern), Grunwaldt, J. (Ekstern), Gabrielsen, J. (Ekstern), Studt, F. (Ekstern)

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**Nitrene-carbene-carbene rearrangement. Photolysis and thermolysis of tetrazolo[5,1-a]phthalazine with formation of 1-phthalazinynitrene, o-cyanophenylcarbene, and phenylcyanocarbene**

1-Azidophthalazine 9A is generated in trace amount by mild FVT of tetrazolo[5,1-a]phthalazine 9T and is observable by its absorption at 2121 cm\(^{-1}\) in the Ar matrix IR spectrum. Ar matrix photolysis of 9T/9A at 254 nm causes ring opening to generate two conformers of (o-cyanophenyl)diazomethane 11 (2079 and 2075 cm\(^{-1}\)), followed by (o-cyanophenyl)carbene 312, cyanocycloheptatetraene 13, and finally cyanophenylcarbene 314 as evaluated by IR spectroscopy. The two carbenes 312 and 314 were observed by ESR spectroscopy (\(D|hc = 0.5078\), \(E|hc = 0.0236\) and \(D|hc = 0.6488\), \(E|hc = 0.0195\) cm\(^{-1}\), respectively). The rearrangement of 12 â., 13 â., 14 constitutes a carbene-carbene rearrangement. 1-Phthalazinynitrene 310 is observed by means of its UV-vis spectrum in Ar matrix following FVT of 9 above 550 C. Rearrangement to cyanophenylcarbenes also takes place on FVT of 9 as evidenced by observation of the products of ring contraction, viz., fulvenallenes and ethynylcyclopentadienes 16-18. Thus the overall rearrangement 10 \(\rightarrow\) 11 \(\rightarrow\) 12 â., 13 â., 14 can be formulated. © 2013 American Chemical Society.

**General information**

**State:** Published

**Organisations:** Department of Chemical and Biochemical Engineering, CHEC Research Centre, University of Queensland

**Authors:** Høj, M. (Intern), Kvaskoff, D. (Ekstern), Wentrup, C. (Ekstern)

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- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 2
- Scopus rating (2013): SJR 2.078 SNIP 1.176 CiteScore 4.51
One-step synthesis of bismuth molybdate catalysts via flame spray pyrolysis for the selective oxidation of propylene to acrolein

Flame spray pyrolysis (FSP) of Bi(III)-and Mo(VI)-2-ethylhexanoate dissolved in xylene resulted in various nanocrystalline bismuth molybdate phases depending on the Bi/Mo ratio. Besides alpha-Bi2Mo3O12 and gamma-Bi2MoO6, FSP gave direct access to the metastable beta-Bi2Mo2O9 phase with high surface area (19 m² g⁻¹). This phase is normally only obtained at high calcination temperatures (>560 degrees C) resulting in lower surface areas. The beta-phase was stable up to 400 degrees C and showed superior catalytic performance compared to alpha- and gamma-phases in selective oxidation of propylene to acrolein at temperatures relevant for industrial applications (360 degrees C).
Selective oxidation of propylene to acrolein by hydrothermally synthesized bismuth molybdates

Hydrothermal synthesis has been used as a soft chemical method to prepare bismuth molybdate catalysts for the selective oxidation of propylene to acrolein. All obtained samples displayed a plate-like morphology, but their individual aspect ratios varied with the hydrothermal synthesis conditions. Application of a high Bi/Mo ratio during hydrothermal synthesis afforded γ-Bi2MoO6 as the main phase, whereas lower initial bismuth contents promoted the formation of α-Bi2Mo3O12. Synthesis with a Bi/Mo ratio of 1:1 led to a phase mixture of α- and γ-bismuth molybdate showing high catalytic activity. The use of nitric acid during hydrothermal synthesis enhanced both propylene conversion and acrolein yield, possibly due to a change in morphology. Formation of β-Bi2Mo2O9 was not observed under the applied conditions. In general, the catalytic performance of all samples decreased notably after calcination at 550 °C due to sintering. © 2014 Elsevier B.V.
A series of molybdenum oxide (2 to 15 wt% Mo) and mixed molybdenum-vanadium oxide (4 to 15 wt% Mo and 2 wt% V) on alumina catalysts have been synthesized by flame spray pyrolysis (FSP). The materials were structurally characterized by BET surface area, X-ray diffraction (XRD), Raman and diffuse reflectance UV-vis spectroscopy and evaluated as catalysts for the oxidative dehydrogenation (ODH) of propane. The results show that samples with high specific surface areas between 122 and 182 m²/g were obtained, resulting in apparent MoOₓ and VOₓ surface densities from 0.7 to 7.7 nm⁻² and 1.5 to 1.9 nm⁻², respectively. Raman spectroscopy, UV-vis spectroscopy and XRD confirmed the high dispersion of molybdenum and vanadia species on γ-Al₂O₃ as the main crystalline phase. Only at the highest loading of 15 wt% Mo, with theoretically more than monolayer coverage, some crystalline molybdenum oxide was observed. For the mixed molybdenum-vanadium oxide catalysts the surface species were separate molybdenum oxide and vanadium oxide monomers at low loadings of molybdenum, but with increasing molybdenum loading interactions between surface molybdenum and vanadium oxide species were observed with Raman spectroscopy. The catalytic experiments showed that the most selective molybdenum oxide catalysts for the ODH reaction were those with high Mo loadings of 7 to 15 wt% Mo, while the most selective mixed molybdenum-vanadium oxide catalyst were at 4 wt% Mo, where separate surface species of molybdenum and vanadium oxide were observed by Raman spectroscopy. A simple kinetic model based on the propane ODH reaction, parallel combustion of propane and sequential combustion of propene described the experimental results well and could be used to determine the optimal reaction conditions. © 2013 Elsevier B.V.
General information
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Organisations: Department of Chemical and Biochemical Engineering, CHEC Research Centre, Technical University of Munich, Haldor Topsoe AS
Authors: Høj, M. (Intern), Kessler, T. (Ekstern), Beato, P. (Ekstern), Jensen, A. D. (Intern), Grunwaldt, J. (Intern)
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Scopus rating (2012): SJR 1.549 SNIP 1.615 CiteScore 3.89
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
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Web of Science (2007): Indexed yes
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Scopus rating (2005): SJR 1.639 SNIP 1.605
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.767 SNIP 1.889
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.637 SNIP 1.959
Scopus rating (2002): SJR 1.753 SNIP 1.532
A series of five vanadia on alumina catalysts for oxidative dehydrogenation of propane to propene were synthesized by flame spray pyrolysis (FSP) using vanadium(III)acetylacetonate and aluminium(III)acetylacetonate dissolved in toluene as precursors. The vanadium loading was 2, 3, 5, 7.5 and 10wt.%. The catalysts were subsequently characterized by BET surface area, X-ray diffraction (XRD), Raman, UV–vis diffuse reflectance and X-ray absorption spectroscopy (XAS) as well as measurement of the catalytic performance. The catalysts had specific surface areas from 143 to 169 m²/g corresponding to average particles diameters from 9.0 to 10.9nm and apparent vanadia surface densities from 1.4 to 8.4 VOₓ/nm². The only crystalline phase detected by XRD was γ-Al₂O₃, except at 10wt.% vanadium where traces of crystalline vanadia were observed. Raman spectroscopy showed vanadia monomers at 2 and 3wt.% V (1.4 and 2.1 VOₓ/nm²), a mixture of vanadia oligomers and monomers at 5wt.% V (3.6 VOₓ/nm²) and mainly oligomers at 7.5 and 10wt.% V (6.0 and 8.4 VOₓ/nm²). Diffuse reflectance UV–vis and extended X-ray absorption fine structure (EXAFS) spectroscopy measurements supported the results of Raman spectroscopy. In situ X-ray absorption near edge structure (XANES) spectroscopy showed that the vanadia can be reduced when operating at low oxygen concentrations. The catalyst performance was determined in fixed bed reactors with an inlet gas composition of C₃H₈/O₂/N₂=5/25/70. The main products were propene, CO and CO₂, with traces of ethene and acrolein. Comparing propene selectivity as function of propane conversion the most selective catalysts were the 2 and 3wt.% V samples, which contained mostly vanadia monomers according to Raman spectroscopy. The best propene yield of 12% was obtained with the 2wt.% vanadium catalyst while the best space time yield of 0.78gpropene/(gcat·h) at 488°C was obtained with the 3wt.% V catalyst.

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Scopus rating (2015): SJR 1.203 SNIP 1.394 CiteScore 4.08
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.303 SNIP 1.574 CiteScore 4.04
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.426 SNIP 1.538 CiteScore 4.01
Two-Nozzle Flame Spray Pyrolysis (FSP) Synthesis of CoMo/Al₂O₃ Hydrotreating Catalysts

Two-nozzle flame spray analysis (FSP) synthesis of CoMo/Al₂O₃ where Co and Al are sprayed in separate flames was applied to minimize the formation of CoAl₂O₄ observed in one-nozzle flame spray pyrolysis (FSP) synthesis and the materials were characterized by N₂-adsorption (BET), X-ray diffraction (XRD), UV–vis diffuse reflectance spectroscopy, Raman spectroscopy, transmission electron microscopy, and catalytic performances in hydrotreating. By varying the flame mixing distances (81–175 mm) the amount of CoAl₂O₄ could be minimized. As evidenced by UV–vis spectroscopy, CoAl₂O₄ was detected only at short flame mixing distances, where the flame conditions resemble one-nozzle FSP. Raman spectroscopy revealed that β-CoMoO₄ was a component of all the catalysts (in the as-prepared oxidic form) together with alumina supported MoOₓ surface species. The only phase detected with XRD was γ-Al₂O₃. The FSP synthesized oxidic catalysts were activated by sulfidation without further heat treatments. The hydrodesulfurization activity of the best two-nozzle FSP catalysts, compared to the one-nozzle FSP catalysts, improved from 75 to 91 % activity relative to a commercial reference catalyst and the hydrodenitrogenation activity improved from 70 to 90 % relative activity. This suggests that better promotion of the active molybdenum sulfide phase was achieved when using two-nozzle FSP synthesis, probably due to less formation of the undesired phase CoAl₂O₄, which makes Co unavailable for promotion.
Flame synthesized vanadium and molybdenum oxide catalysts for oxidative dehydrogenation of propane

General information
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Organisations: Department of Chemical and Biochemical Engineering, CHEC Research Centre
Authors: Høj, M. (Intern), Jensen, A. D. (Intern), Grunwaldt, J. (Intern)
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Main Research Area: Technical/natural sciences
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Flame synthesized vanadia catalysts for oxidative dehydrogenation of propane

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Organisations: Department of Chemical and Biochemical Engineering, CHEC Research Centre
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Main Research Area: Technical/natural sciences
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Nanoparticle synthesis using flame spray pyrolysis for catalysis

Roughly 85 to 90 % of the products from the chemical industry have been in contact with a catalyst and the production volume and financial turnover of the catalyst industry are expected to increase in the near future. This growth will be fueled by increasing demands for chemicals, new catalytic processes based on renewable feedstock, new or improved ways of preparing catalysts and a better understanding of the catalyst structure at operating conditions. This thesis explores flame spray pyrolysis (FSP) as a novel one-step preparation method for heterogeneous catalysts and investigates structure-activity-selectivity relationships. Specific catalysts studied are cobalt-molybdenum hydrotreating catalysts and vanadium and molybdenum oxide catalysts for oxidative dehydrogenation of propane (ODP). Hydrotreating is an established field in the petrochemical industry, driven by strict legislation on sulfur and nitrogen content in transportation fuels. Research is therefore performed to improve the commercial catalysts. In this thesis, FSP prepared catalysts are demonstrated to have an activity of up to 91 % of a commercial reference. This is promising for a new synthesis method which has not yet been optimized. The catalysts structure was investigated by spectroscopy and electron microscopy. ODP is an exothermic, alternative process
to current highly energy demanding propene production methods; however the propene selectivity is a major obstacle for commercialization. FSP prepared vanadia catalysts with low vanadium loadings gave propene yields of up to 13 % at 33 % propane conversion and space time yields of up to 0.88 gpropene/(gcat·h), which competes well with vanadia catalysts prepared by other methods. Kinetics of the reaction and the catalyst structure were investigated by in-situ and ex-situ by e.g. X-ray absorption and Raman spectroscopy.

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**One and two flame synthesis of CoMo/Al2O3 and CoMo/Al2O3-SiO2 hydrotreating catalysts**

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Organisations: Department of Chemical and Biochemical Engineering, CHEC Research Centre, Haldor Topsoe AS, University of Bremen
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**CoMo/Al2O3 hydrotreating catalysts prepared by flame synthesis**

**General information**

State: Published
Organisations: CHEC Research Centre, Department of Chemical and Biochemical Engineering, Haldor Topsoe AS
Authors: Høj, M. (Intern), Brorson, M. (Ekstern), Jensen, A. D. (Intern), Grunwaldt, J. (Intern)
Publication date: 2011
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**Flame made V/Al2O3 propane oxidative dehydrogenation catalyst**

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Flame spray synthesis of CoMo/Al2O3 hydrotreating catalysts

The first alumina supported and unsupported cobalt molybdenum hydrotreating catalysts have been prepared by one-step flame spray pyrolysis (FSP) by spraying and combusting tris(acetylacetonato)aluminum, cobalt 2-ethylhexanoate and molybdenum 2-ethylhexanoate dissolved in toluene. The oxide particles produced contained varying amounts of transition metals (8, 16, 24 and 32wt.% Mo with atomic ratio Co/Mo=1/3 and 16wt.% Mo with atomic ratios Co/Mo=2/3 and 1/1) with alumina constituting the balance. In addition, an unsupported reference catalyst (atomic ratio Co/Mo=1/3) was produced. The particles obtained consisted mostly of γ-Al2O3 with some CoAl2O4, as evidenced by X-ray diffraction (XRD) and UV–vis spectroscopy. Bulk MoO3 was not detected by XRD, except at the highest molybdenum content (32wt.%) and in the unsupported sample, indicating that molybdenum is well dispersed on the surface of the support. The specific surface area as measured by nitrogen adsorption (BET) decreased from 221 to 90m2/g when going from the lowest loading supported catalyst (8wt.% Mo) to the unsupported reference. Transmission electron microscopy (TEM) images showed that at low molybdenum loadings nanoparticle agglomerates with 5–10nm primary particles were produced. As the molybdenum loading on the alumina was increased from 8 to 32wt.% Mo and for the unsupported reference the primary particle size increased to up to 20nm and the morphology became more irregular due to primary particle sintering and aggregation. After activation by sulfidation the activity of the catalysts were measured for the three hydrotreating reactions hydrodesulfurization, hydrodenitrogenation and hydrogenation using a model oil containing dibenzothiophene, indole and naphthalene in n-heptane solution. The best catalyst was the FSP-produced material containing 16wt.% Mo (atomic ratio Co/Mo=1/3), which did not contain crystalline MoO3 and only small amounts of CoAl2O4. The hydrotreating activity was approximately 75% of that of commercial cobalt molybdenum catalysts prepared by wet impregnation of pre-shaped alumina extrudates. Since the commercial catalyst is the product of years of development, this shows the potential of the flame spray pyrolysis technique. The Co–Mo–S phase, active for hydrotreating, is formed upon sulfidation of the flame made oxide precursor. TEM images of the spent catalysts showed that as the metal loading was increased from 8 to 32wt.% Mo the average length of supported MoS2 entities increased from 3 to 4nm (for the unsupported catalyst it was 8.5nm), while the average number of MoS2 layers per particle increased from 1.1 to 2.5. The increase in MoS2 particle size resulted in lower activity.
Flame synthesized CoMo/Al2O3 hydrotreating catalysts

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Publication date: 2011
Event: Abstract from 8th European Congress of Chemical Engineering, Berlin, Germany.
Main Research Area: Technical/natural sciences
Electronic versions:
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Characterization of Fe-zeolite catalysts for NH3-scr OF NOx in diesel exhaust

General information
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Authors: Høj, M. (Intern), Beier, M. J. (Intern), Grunwaldt, J. (Intern), Dahl, S. (Intern)
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Main Research Area: Technical/natural sciences
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Source-ID: 266140
Publication: Research › Conference abstract for conference – Annual report year: 2010

Nature of Active Sites of Fe-Beta Catalyst for NOx-SCR by NH3
A correlation of the reaction rate over Fe-Beta catalysts with a concentration of specific isolated Fe3+ sites represented by an ESR signal at g ≈ 4.3 and by UV adsorption bands with λmax <300 nm was observed. Blocking zeolite cationic positions with Ca2+ and investigation of “Fe-free” Beta-zeolites confirmed the idea of isolated Fe complexes in cationic positions being active sites for NH3-deNOx.
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Authors: Doronkin, D. E. (Ekstern), Stakheev, A. Y. (Ekstern), Kucherov, A. V. (Ekstern), Tolkachev, N. N. (Ekstern), Kustova, M. (Ekstern), Høj, M. (Intern), Baeva, G. N. (Ekstern), Bragina, G. O. (Ekstern), Gabrielsson, P. (Ekstern), Gekas, I. (Ekstern), Dahl, S. (Ekstern)
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BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.989 SNIP 0.862 CiteScore 2.29
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.125 SNIP 0.837 CiteScore 2.67
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.196 SNIP 0.851 CiteScore 2.49
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.346 SNIP 0.977 CiteScore 2.89
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
The role of monomeric iron during the selective catalytic reduction of NOx by NH3 over Fe-BEA zeolite catalysts

General information
State: Published
Organisations: CHEC Research Centre, Department of Chemical and Biochemical Engineering, Haldor Topsoe AS
Authors: Høj, M. (Intern), Beier, M. J. (Intern), Grunwaldt, J. (Intern), Dahl, S. (Ekstern)
Pages: 166-176
Publication date: 2009
Main Research Area: Technical/natural sciences

Publication information
Journal: Applied Catalysis B: Environmental
Volume: 93
Issue number: 1-2
ISSN (Print): 0926-3373
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 8.86 SJR 2.583 SNIP 2.12
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 2.26 SNIP 2.081 CiteScore 7.72
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 2.232 SNIP 2.164 CiteScore 6.92
Web of Science (2014): Indexed yes
Tetrathiafulvalene-functionalized triptycenes: synthetic protocols and elucidation of intramolecular Coulomb repulsions in the oxidized species

A large selection of triptycenes functionalized with tetrathiafulvalene (TTF) units as well as triptycenes containing extended TTFs as a part of the triptycene core have been synthesized utilizing new triptycene di- and tetraaldehydes as well as bis-, tetrakis- and hexakis(bromomethyl) derivatives. The largest scaffold contains a total of 12 TTFs around the central triptycene core. From spectrot electrochemical and chemical oxidation studies, we have elucidated the extent to which an increasing number of electrostatic interactions among oxidized TTF units exert an influence on the absorption characteristics.

General information
State: Published
Organisations: Academy of Sciences of the Czech Republic, University of Copenhagen
Authors: Rybacek, J. (Ekstern), Rybackova, M. (Ekstern), Høj, M. (Intern), Belohradsky, M. (Ekstern), Holy, P. (Ekstern), Kilsa, K. (Ekstern), Nielsen, M. B. (Ekstern)
Pages: 8840-8854
Publication date: 2007
Projects:

**Catalytic Cracking of Sugars for Production of Chemicals**
Department of Chemical and Biochemical Engineering
Period: 01/11/2017 → 31/10/2020
Number of participants: 4
Phd Student:
Schandel, Christian Bækhøj (Intern)
Supervisor:
Høj, Martin (Intern)
Osmundsen, Christian Mårup (Intern)
Main Supervisor:
Jensen, Anker Degn (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

**Hydrogen assisted catalytic biomass pyrolysis for green fuels**
Department of Chemical and Biochemical Engineering
Period: 01/10/2015 → 30/09/2018
Number of participants: 5
Phd Student:
Stummann, Magnus Zingler (Intern)
Supervisor:
Høj, Martin (Intern)
Jensen, Peter Arendt (Intern)
Sundet, Jostein K. (Ekstern)
Main Supervisor:
Jensen, Anker Degn (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

**Next Generation Methanol to Foramiddehyde Selective Oxidation Catalysts**
Department of Chemical and Biochemical Engineering
Period: 01/10/2015 → 30/09/2018
Number of participants: 3
Phd Student:
Raun, Kristian Viegaard (Intern)
Supervisor:
Høj, Martin (Intern)
Main Supervisor:
Jensen, Anker Degn (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Samfinansierede - Virksomhed
Project: PhD

**New catalysts for hydrodeoxygenation of biomass pyrolysis oil**
Department of Chemical and Biochemical Engineering
Period: 01/04/2014 → 27/11/2017
Number of participants: 4
Phd Student:
Dabros, Trine Marie Hartmann (Intern)
Supervisor:
Grunwaldt, Jan-Dierk (Intern)
Høj, Martin (Intern)
Main Supervisor:
Jensen, Anker Degn (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Nanoparticle synthesis using flame spray pyrolysis for catalysis
Department of Chemical and Biochemical Engineering
Period: 01/09/2009 → 28/01/2013
Number of participants: 7
Phd Student:
Høj, Martin (Intern)
Supervisor:
Elmøe, Tobias Dokkedal (Intern)
Grunwaldt, Jan-Dierk (Intern)
Main Supervisor:
Jensen, Anker Degn (Intern)
Examiner:
Fehrmann, Rasmus (Intern)
Christensen, Kurt Agerbæk (Ekstern)
Schomäcker, Reinhard (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD