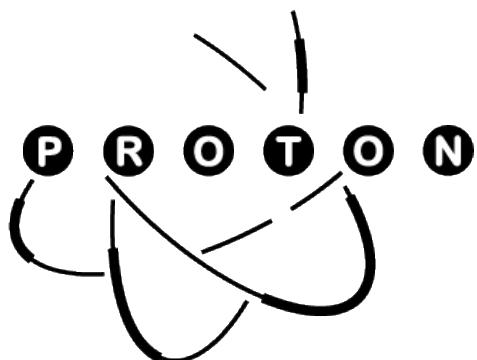
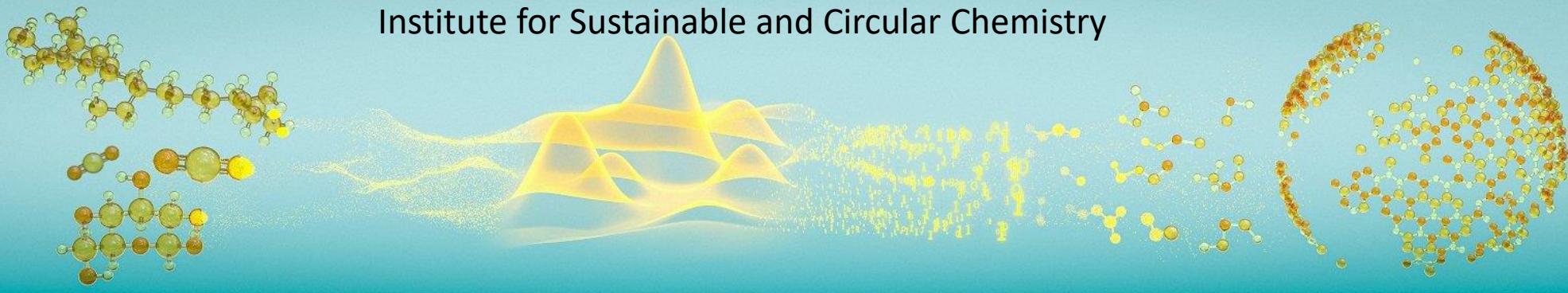


Organic Chemistry and Catalysis

Sectie informatie avond

Institute for Sustainable and Circular Chemistry



**Eva Harsevoort
Marie Velada Dugois**
Utrecht, Netherlands
24 October 2023

The OCC Group

The Professors



Isabel
Arends



Bert Klein
Gebbink



Pieter
Bruijnincx



Associate/assistant professors



Marc-Etienne
Moret



Danny
Broere



Arnaud
Thevenon

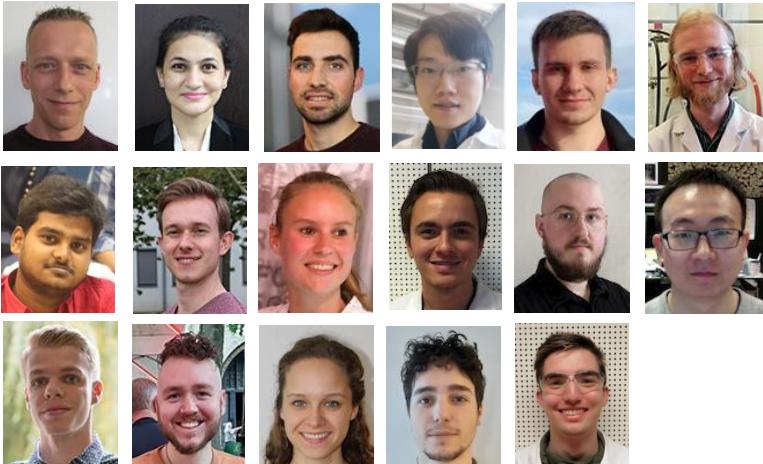


Matthias
Schwalbe



The Rest of Us

3 post-docs, 13 PhDs, many students!



Permanent Staff



Silvia
Benschop



Johann
Jastrzebski



Thomas
Ran



Léon
Witteman



The OCC Research



Catalysis with Organometallic Complexes

prof. dr. Bert Klein Gebbink

dr. Marc-Etienne Moret

dr. ing. Danny Broere



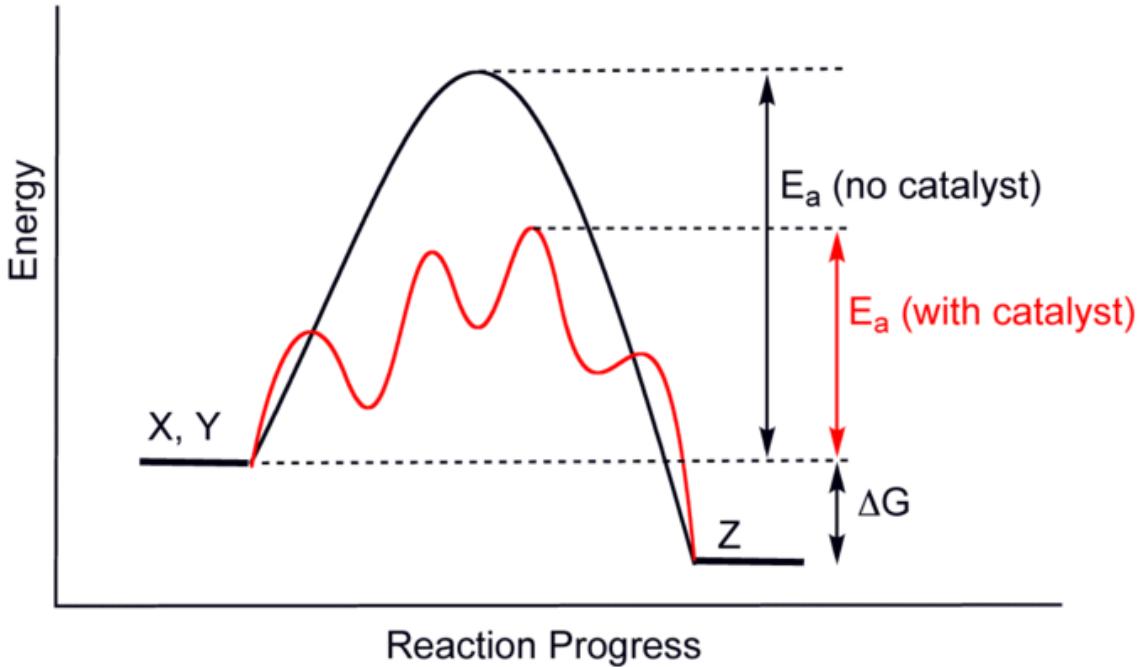
Catalysis for Renewable Feedstocks

prof. dr. Pieter Bruijnincx

dr. Arnaud Thevenon

Catalysis

What is a catalyst?

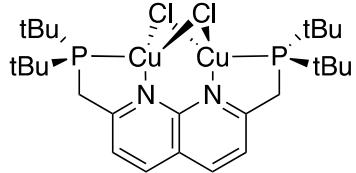
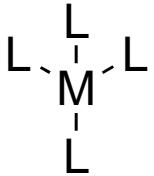


Different aspects of catalysis:

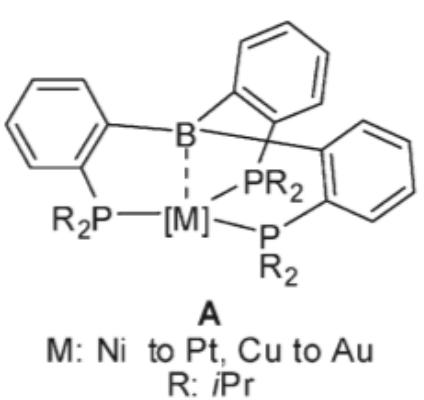
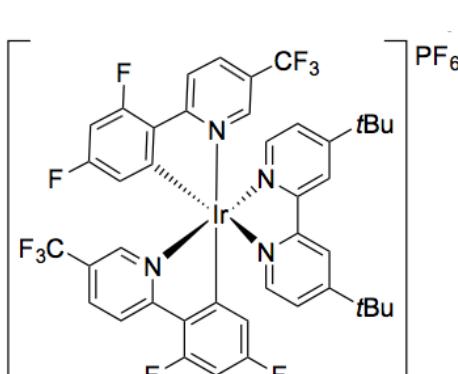
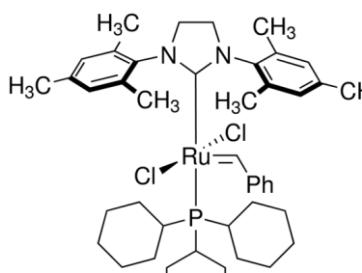
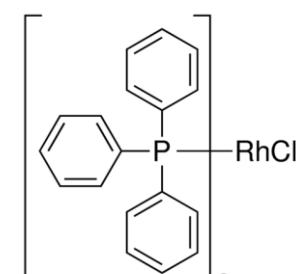
- Which catalyst do we use?
- How can we use that catalyst?

Catalysis with Organometallic Complexes

What is an organometallic complex?



THE PERIODIC TABLE OF THE ELEMENTS																				
1	IA	2	IA	3	IIA	4	IVA	5	VIA	6	VIA	7	VIIA	8	VIIA	9	VIIA	10		
H	Hydrogen	3.00	Be	Beryllium	8.00	Li	Lithium	6.94	Na	Sodium	22.99	Mg	Magnesium	24.31	Al	Aluminum	26.98	He	Helium	4.00
Li	Lithium	6.94	Be	Beryllium	8.00	Na	Sodium	22.99	Mg	Magnesium	24.31	Ca	Calcium	40.08	Sc	Scandium	44.96	C	Carbon	12.01
Na	Sodium	22.99	Be	Beryllium	8.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Ti	Titanium	45.96	V	Vanadium	50.94	N	Nitrogen	14.01
Mg	Magnesium	24.31	Be	Beryllium	8.00	Sc	Scandium	44.96	Ti	Titanium	45.96	Cr	Chromium	51.99	Mn	Manganese	54.94	O	Oxygen	16.00
K	Potassium	39.09	Ca	Calcium	40.08	Sc	Scandium	44.96	V	Vanadium	50.94	Fe	Iron	55.85	Co	Cobalt	58.93	F	Fluorine	19.00
Rb	Rubidium	85.47	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Mn	Manganese	54.94	Ni	Nickel	58.69	Ne	Neon	20.18
Sr	Strontium	87.62	Ca	Calcium	40.08	Sc	Scandium	44.96	Fe	Iron	55.85	Co	Cobalt	58.93	Cu	Copper	63.55	He	Helium	4.00
Y	Yttrium	88.91	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Al	Aluminum	26.98
Zr	Zirconium	91.24	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Co	Cobalt	58.93	Zn	Zinc	65.40	C	Carbon	12.01
Nb	Niobium	91.98	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Al	Aluminum	26.98	N	Nitrogen	14.01
Mo	Molybdenum	95.94	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Co	Cobalt	58.93	Zn	Zinc	65.40	O	Oxygen	16.00
Tc	Techneium	98.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	F	Fluorine	19.00
Ru	Ruthenium	101.05	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Co	Cobalt	58.93	Zn	Zinc	65.40	Ne	Neon	20.18
Rh	Rhodium	102.91	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Ar	Argon	39.95
Pd	Palladium	106.42	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Co	Cobalt	58.93	Zn	Zinc	65.40	He	Helium	4.00
Ag	Silver	107.87	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Al	Aluminum	26.98
Cd	Cadmium	112.41	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Co	Cobalt	58.93	Zn	Zinc	65.40	N	Nitrogen	14.01
In	Inium	113.41	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	O	Oxygen	16.00
Sn	Tin	114.81	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Co	Cobalt	58.93	Zn	Zinc	65.40	F	Fluorine	19.00
Sb	Antimony	117.85	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Ne	Neon	20.18
Te	Tellurium	121.76	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Co	Cobalt	58.93	Zn	Zinc	65.40	Ar	Argon	39.95
I	Iodine	126.90	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Xe	Xenon	54.93
Rn	Radon	222.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	He	Helium	4.00
Fr	Rutherfordium	257.80	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Al	Aluminum	26.98
Ra	Rutherfordium	258.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	N	Nitrogen	14.01
Rf	Rutherfordium	259.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	O	Oxygen	16.00
Db	Dubnium	261.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	F	Fluorine	19.00
Sg	Sesrovium	262.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Ne	Neon	20.18
Bh	Bohrium	264.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Ar	Argon	39.95
Hs	Hassium	265.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Xe	Xenon	54.93
Mt	Methmerium	267.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	He	Helium	4.00
Ds	Darmstadtium	268.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Al	Aluminum	26.98
Rg	Roentgenium	269.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	N	Nitrogen	14.01
Cn	Copernicium	270.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	O	Oxygen	16.00
Uut	Ununtrium	274.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	F	Fluorine	19.00
Fl	Florium	275.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Ne	Neon	20.18
Uup	Ununpentium	277.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Ar	Argon	39.95
Lv	Livermorium	278.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Xe	Xenon	54.93
Uus	Ununseptium	279.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	He	Helium	4.00
Uuo	Ununoctium	280.00	Ca	Calcium	40.08	Sc	Scandium	44.96	Cr	Chromium	50.94	Fe	Iron	55.85	Zn	Zinc	65.40	Al	Aluminum	26.98



The OCC Lab

Where does our chemistry happen?



NMR



GC & Mass Spec



The Synthesis Lab



Gloveboxes



EPR



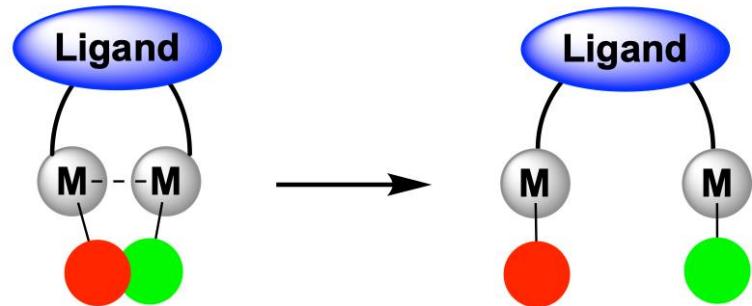
Infra Red (IR)

What do students do at the OCC ?

You can be involved in one or several parts of a project:

- Ligand design and synthesis
- Complexation between metal source and ligand
- Catalytic reaction tests (catalysis)
- Density functional theory (DFT) calculations
- Lignin structure modelling
- Spectroscopy
- Monomer synthesis
- Polymerization reactions

Multimetallic Cooperative Bond Activation



Danny Broere



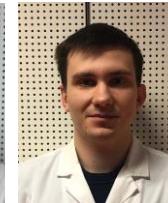
David



Roel

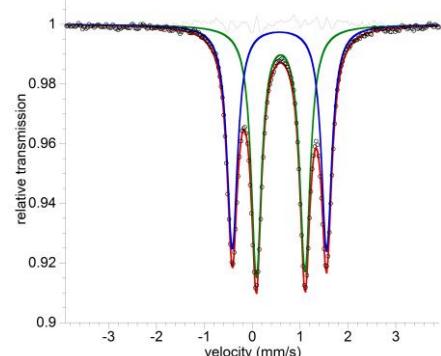
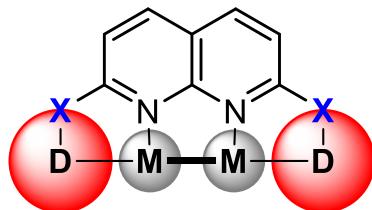


Errikos



Stas

Synthesis



Spectroscopy



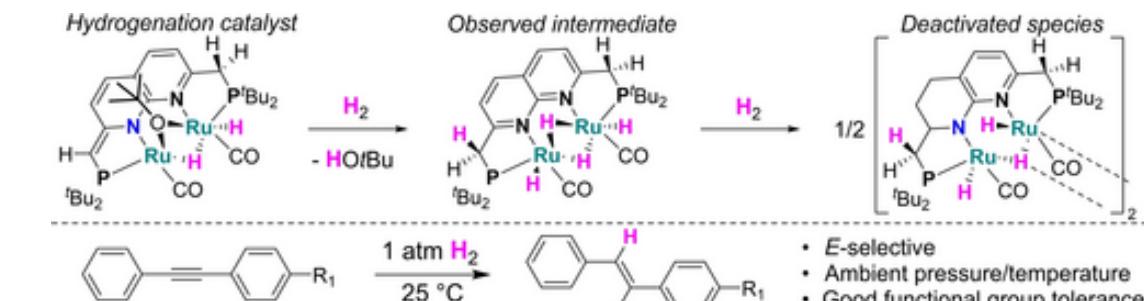
Annemijn



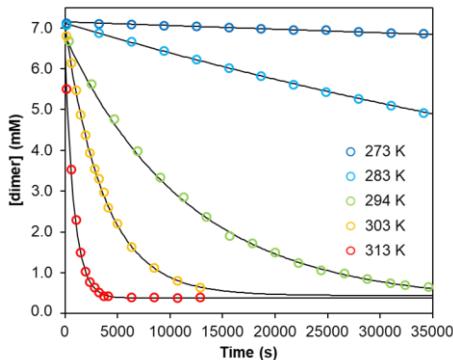
Puck



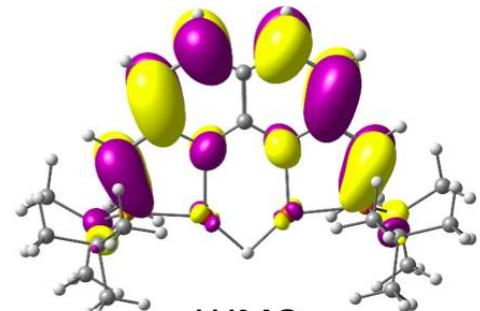
Marie



Mechanism



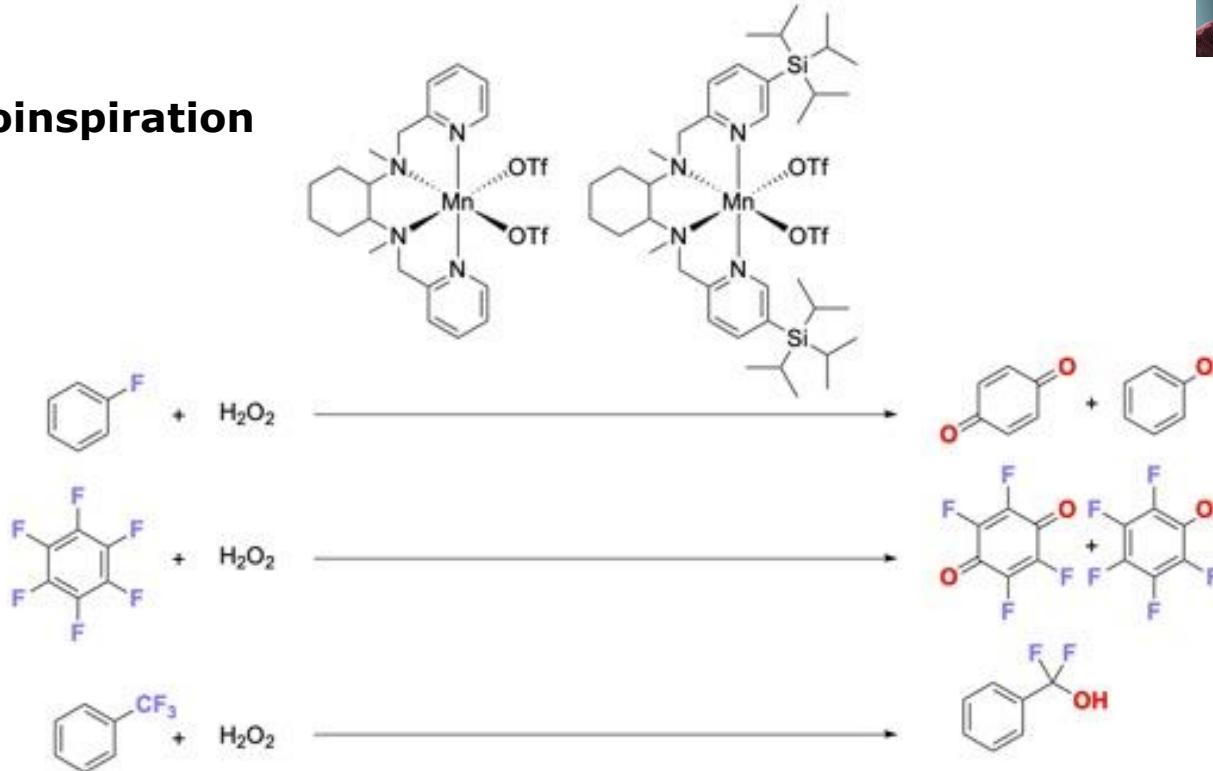
Computations



LUMO

Catalysis for Energy

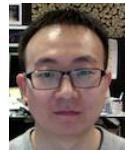
Bioinspiration



Bert



Thomas

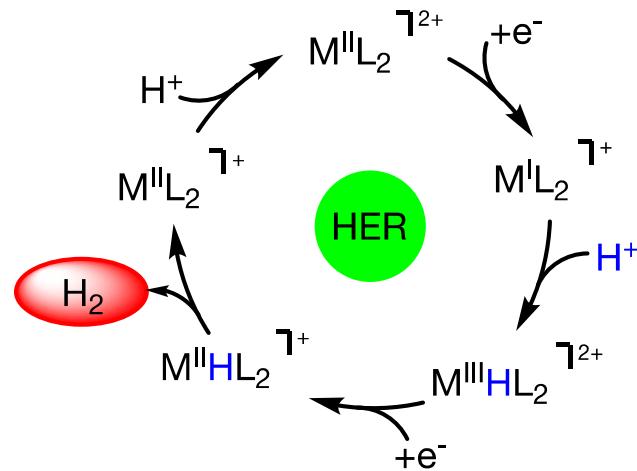


Fanshi



Angshuk

Mechanism



Mechanistic investigation of late-TM catalysts

Mechanistic investigation using DFT calculations

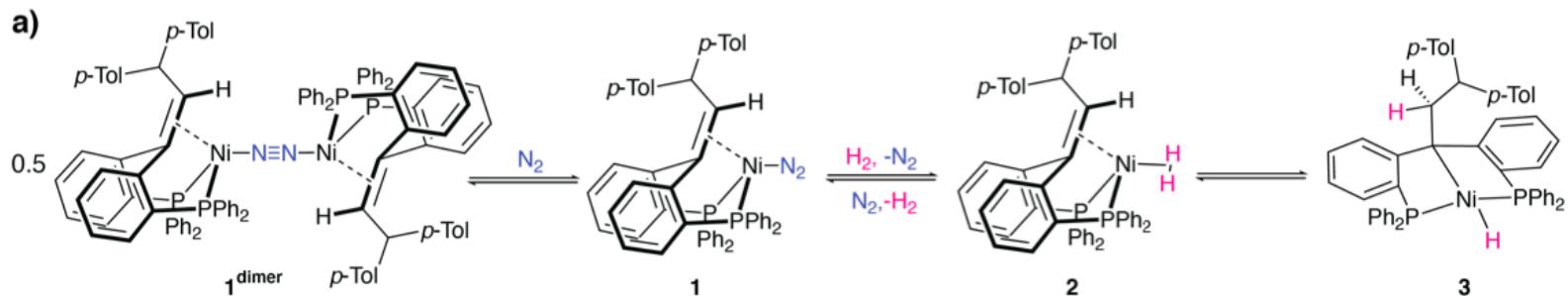
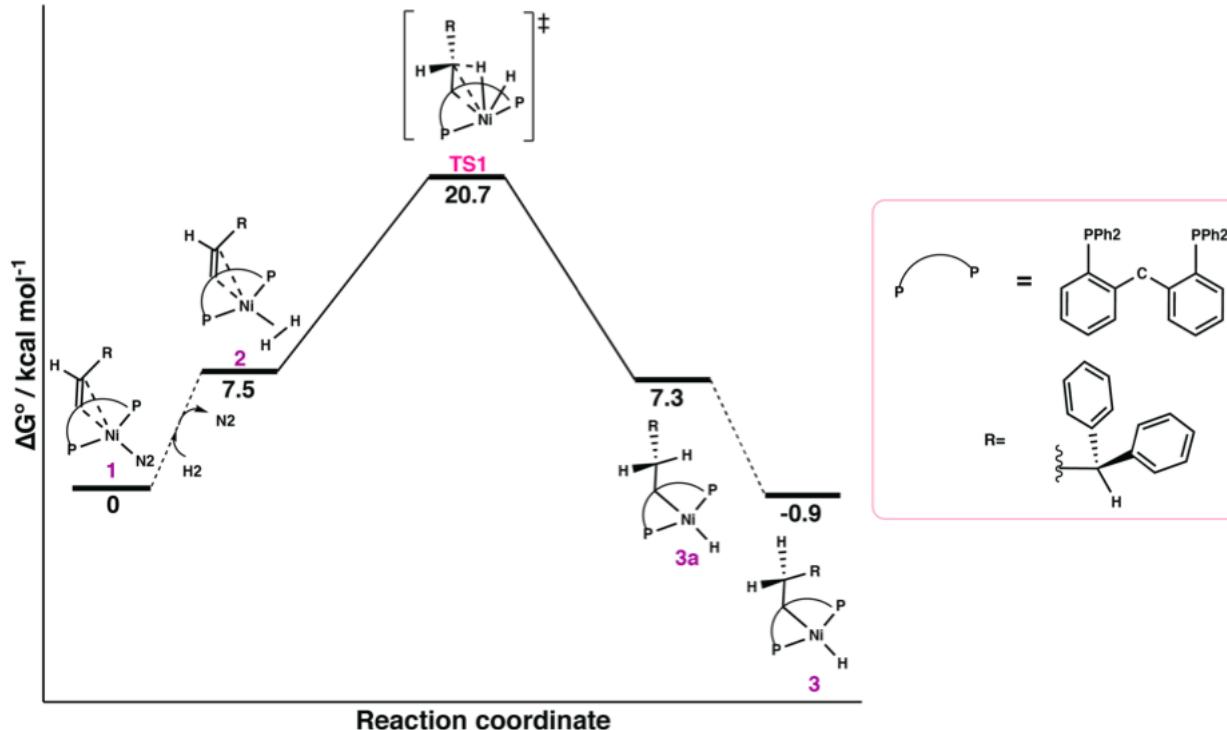


Marc-Etienne

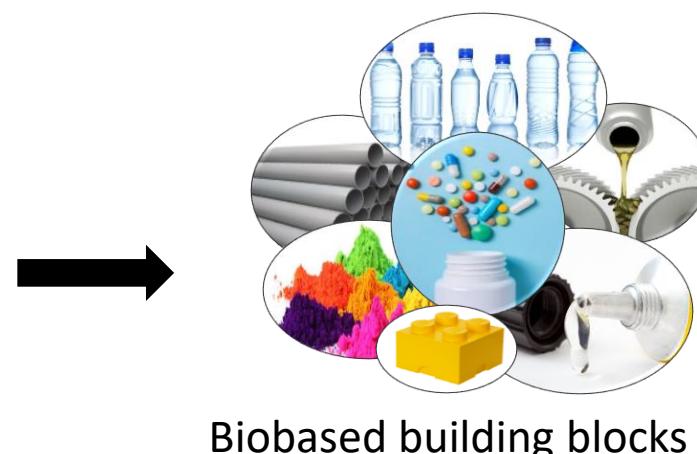
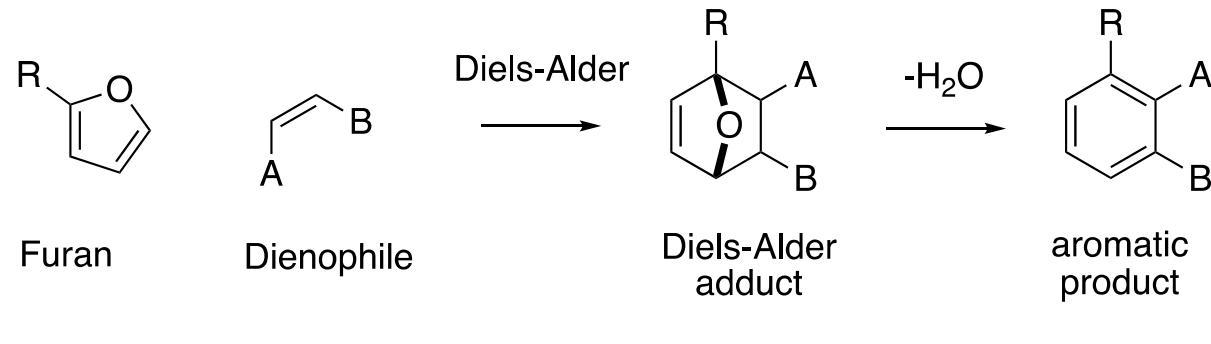
Maria



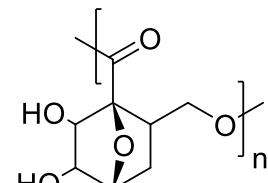
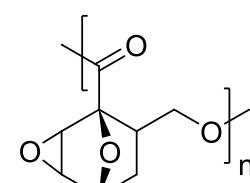
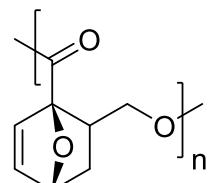
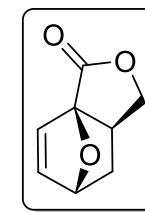
Chinky



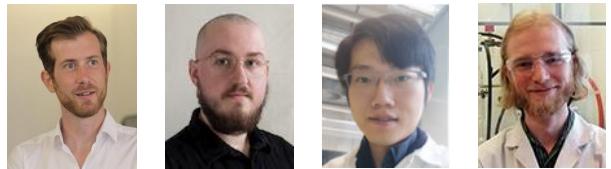
Renewable feedstock from biomass conversion



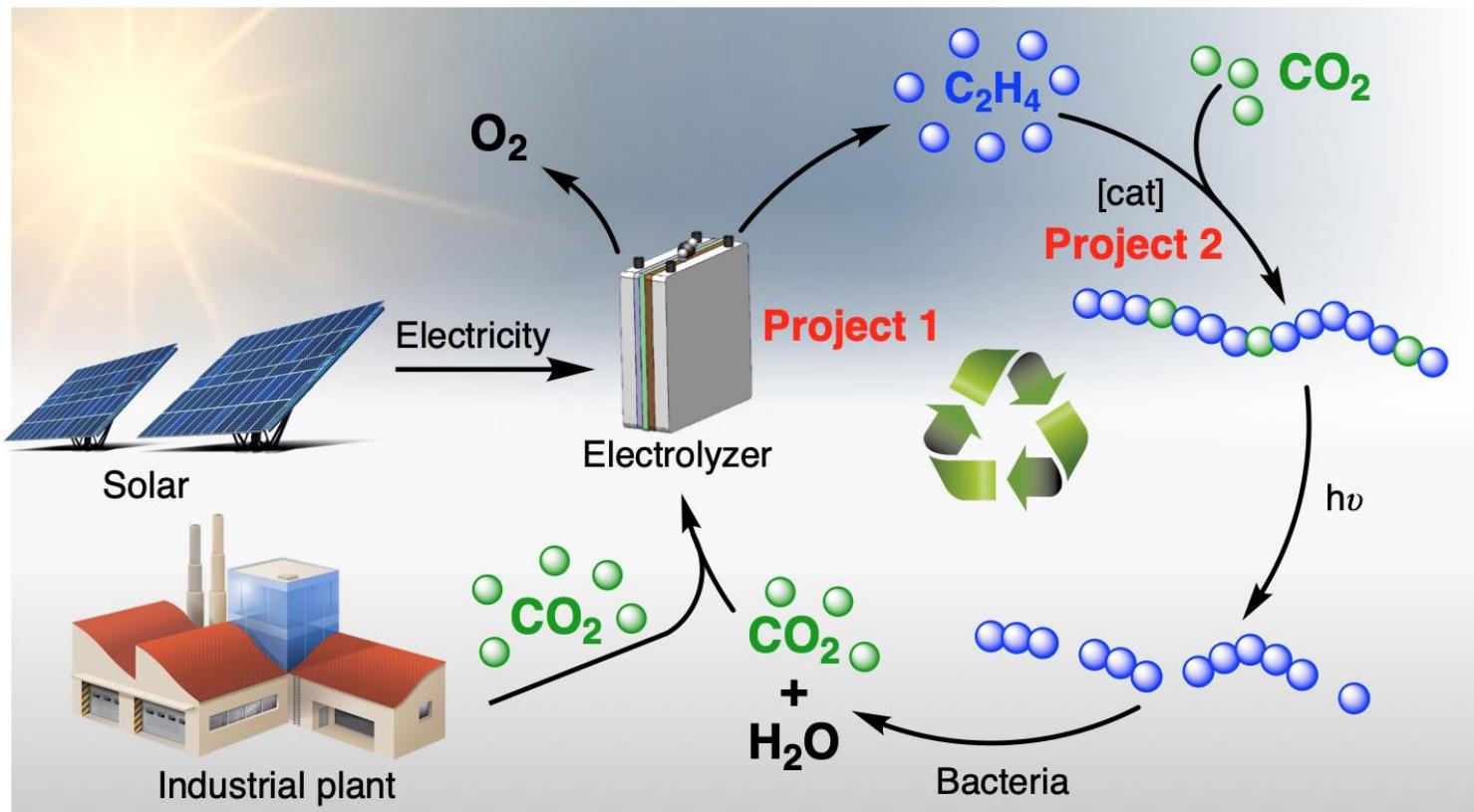
Goal:
Plastics that are
recyclable or biodegradable



Catalysis for CO_2 conversion



Arnaud Björn Weizhe Lars



- Electrocatalysts for CO_2 reduction
- Homogeneous metal catalysts for CO_2 copolymerization

Other subjects in our group

- Aryl-ether activation with di-cobalt complexes (**Danny**, Roel)
- Bioinspired catalysis (**Bert**, Fanshi, Angshuk)
- Acceptor π -ligands for the stabilization of Nickel carbenes (**Marc-Etienne**, Maria)
- Multinuclear Early-Early/Early-late TM complexes (**Danny**, Errikos)
- Polyolefin upcycling (**Pieter**, Maartje)
- Electrochemical CO₂ reduction (**Arnaud**, Lars)
- Lignin valorization (**Pieter**, Luke, Thomas)
- Salen nickel(II) complexes for CO₂ copolymerization (**Arnaud**, Björn)

Beyond Science...



"Smaller" group → more personal contact together

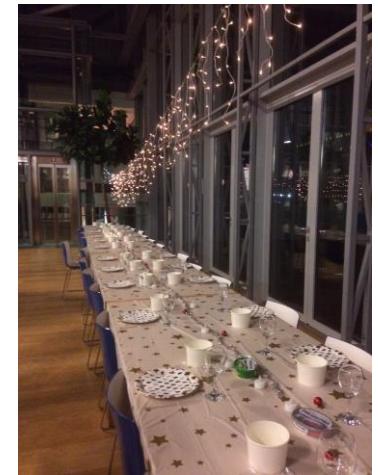
OCC Group Outing



Borrels



Christmas Dinner



OCC Barbecue



OCC Camping Trip (unofficial)



Thank you for your attention!



Questions ?

Contact information

Dr. Arnaud Thevenon-Kozub a.a.thevenon-kozub@uu.nl

- 2nd year students, contact Arnaud
- Bachelor students: motivation letter
- Master students: motivation letter + CV