



Applied and Analytical Chemistry



Analytical Services for Innovative Materials Research

Prof. Dr. Robert Carleer, Dr. ir. Pieter Samyn



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KNOWLEDGE IN ACTION

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universiteit
hasselt | umec
IMO - IMOMEC
INSTITUUT VOOR MATERIAALONDERZOEK

Institute of Materials Research – IMO - IMOMECC

... focusses on the study of advanced material systems to contribute by innovation to the societal drivers of our time and region,

... develops synergies between fundamental/basic research and applied research until achieving technological innovation with economic valorization potential.



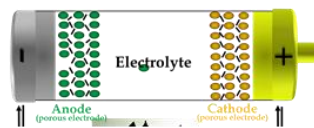
Energy production

Thin-film photovoltaic systems



Energy Storage

Battery systems



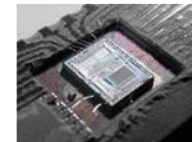
Sustainable Materials

Valorization of biomass

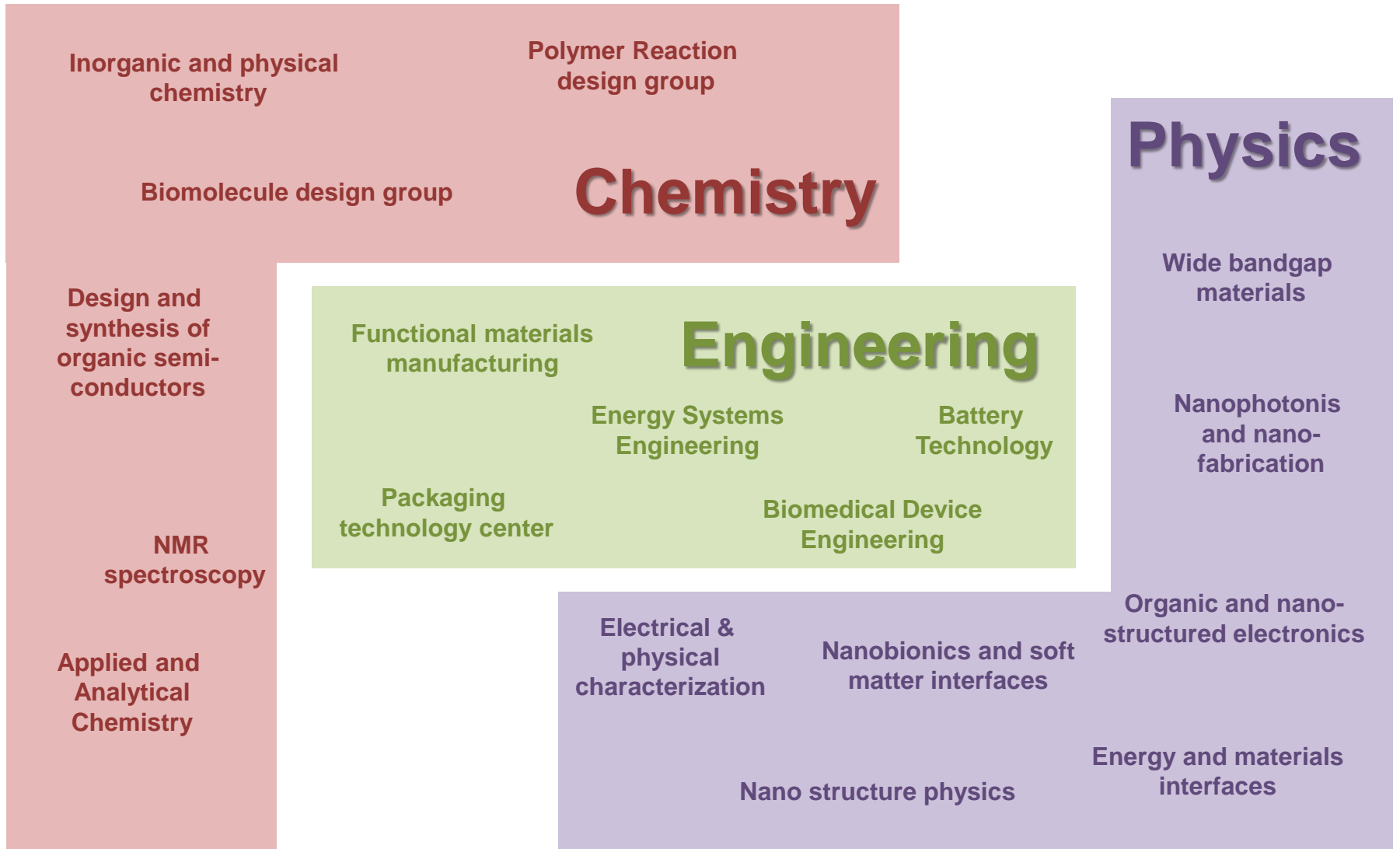


Health

Medical diagnostics:
biosensors and -electronics



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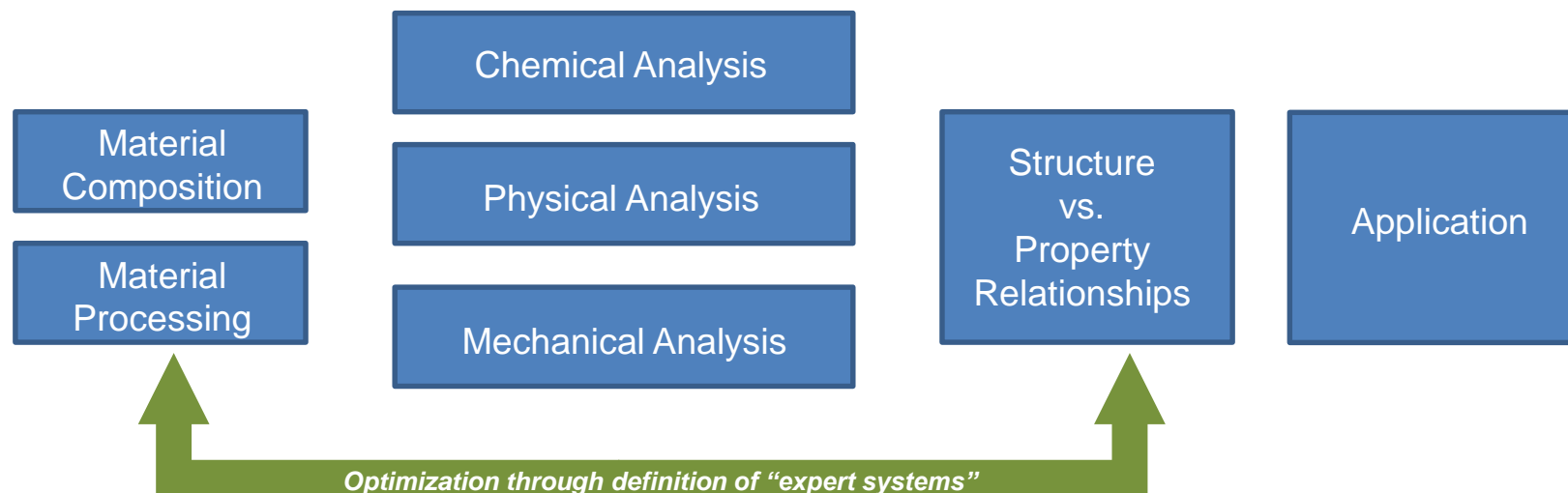


Applied & Analytical Chemistry (*TANC*)

Development of analytical strategies and dedicated analytical methods for the study of advanced material systems with focus on *(bio)polymers*, *rubbers*, *resins* and *coatings* using complementary (hyphenated) analytical techniques.

Fundamental & Applied & Contract Research
on new applications, processing, performance, sustainability

Environmentally-oriented Research: contaminants & side-stream valorization



Prof. Dr. Robert Carleer
Dr. Ir. Pieter Samym
Prof. Dr. Em. Jan Yperman
Prof. Dr. Peter Adriaensens (NMR spectroscopy)

6 Ph.D. students
6 Sr. Researchers
6 Sr Technicians

Analytical Expertise

Elemental Analysis

AAS

ICP-OES

ICP-MS

XRF



Chromatography

IC

GC GC-MS

HPLC

GPC

LC-MS



Spectroscopy

NMR

FTIR

UV-VIS-NIR

MS

Raman



Rheology

Plate

Cone



Thermal Analysis

DSC TGA

DMA TMA



Coupled

Techniques

Headspace-, thermal desorption-, pyrolysis – GC-MS, IC-ICP-MS

FT-IR microscopy

TG coupled techniques TG-FT-IR, TG-MS, TG-TD-GC-MS



Case Studies

Particle detection and characterization

Real-time single nanoparticle ICP-MS (μs measuring times !)

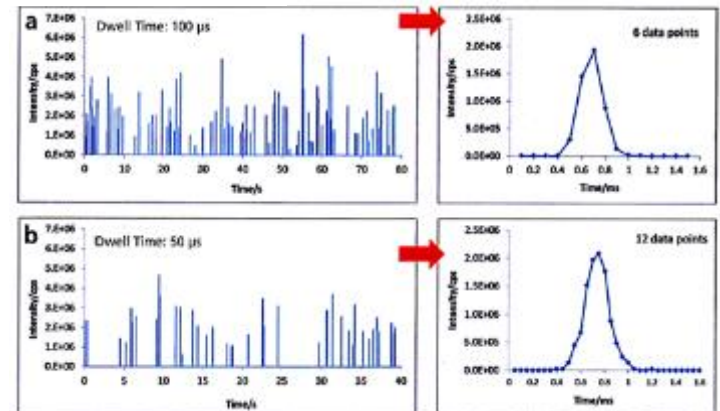
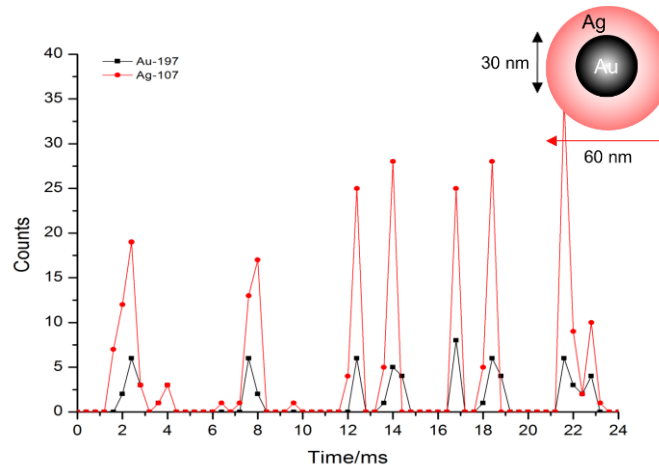
- elemental composition (< ppb)
- number of particles
- particle size
- particle size distribution

Traditional Particle size & stability

- micro- to nanometer particle size
- field flow fractionation
- zeta potential measurements

Applications

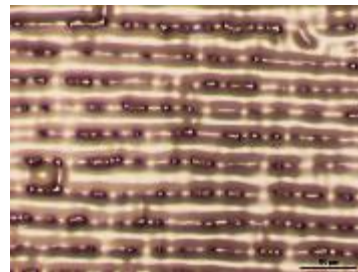
- drinkwater, waste-water
- blood, urine
- processing liquids
- corrosion
- extracts of solid materials
- slurries of abrasive polishing
- cosmetics



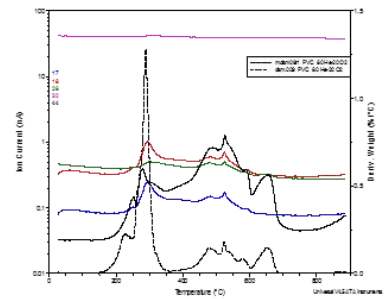
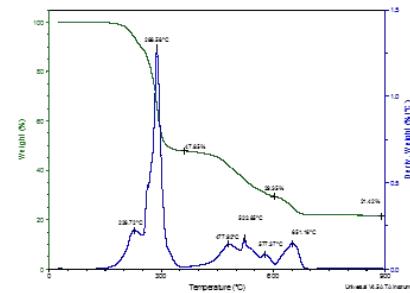
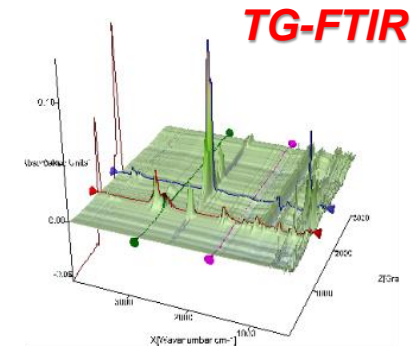
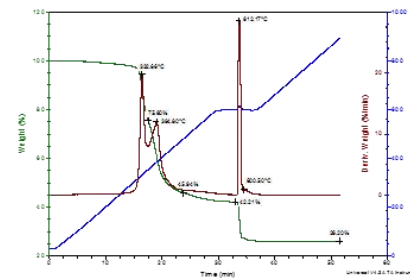
Case Studies

Processing behaviour and composition of polymers

- Study of thermal features and properties of polymers (VOC, cure behaviour, degradation, fogging,...)
- Material failure analysis & troubleshooting (die and mould contamination, adhesion problems, processing problems)
- Analysis of additives as a function of the emission of volatile components
- Doublesided tape with recycling abilities
- Wastefree degreasing proces with guaranteed high degreasing speed and -quality
- Low formaldehyde emitting glues for wood
- Delamination of PVC on MDF board
- Phenolic resins, UF resins, foams
- Adhesion problems
- Contaminants
- Coating defects



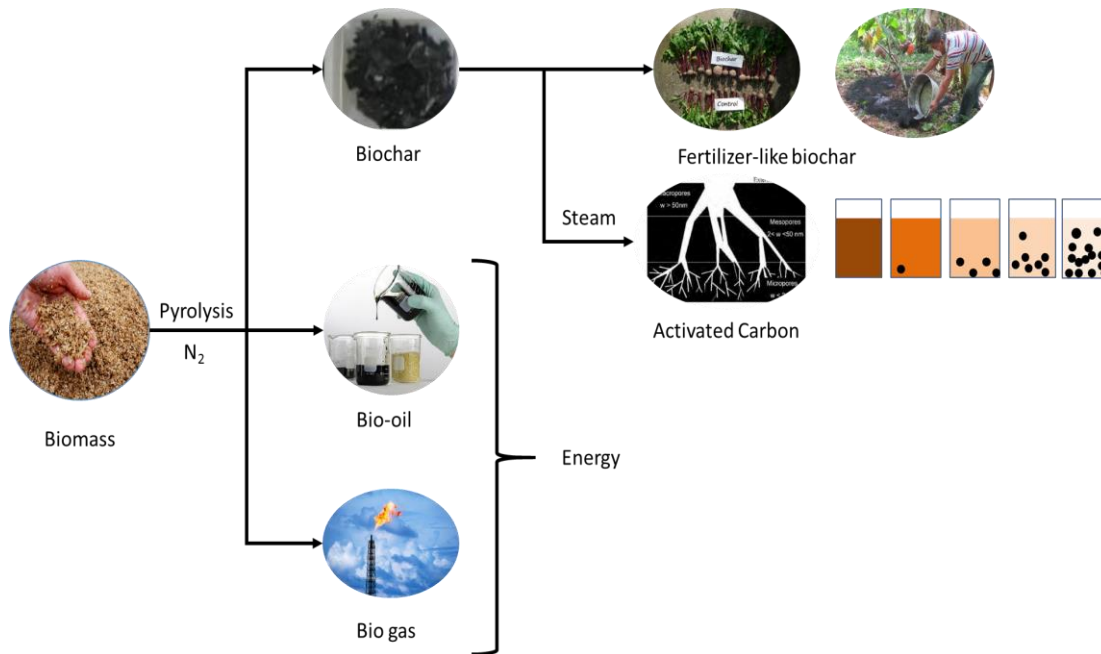
Rheological instability in polymer coatings



TG-MS

Core Research Topics: Pyrolysis

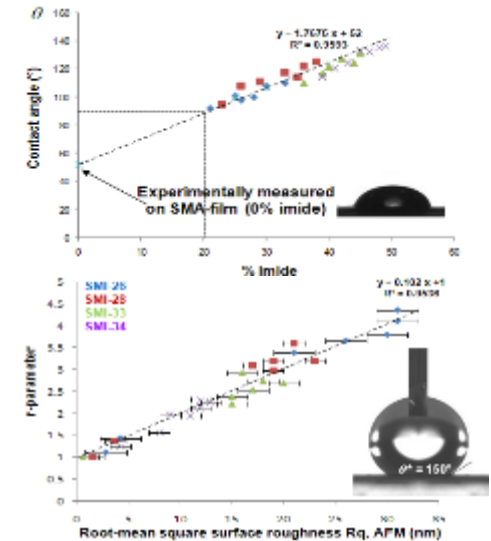
Valorization of materials from contaminated biomass (with heavy metals) or organic rest streams (biomass/biopolymers) into value-added products by using (co-) pyrolysis techniques (biochar, activated carbon, electrodes)



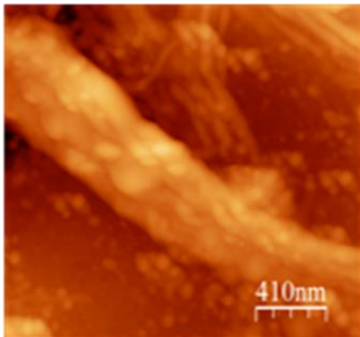
- Chemical and energetical valorization of pyrolysis products
 - upgrade bio-oil as a secondary feedstock with added value for the preparation of chemicals
 - validate the bio-oil as a bio-fuel with higher heating value and to obtain a more homogeneous composition, free of heavy metals and with low concentration of pyrolytic water
- Improving processing parameters and yields of bio-oil

Core Research Topics: Bio-based Materials

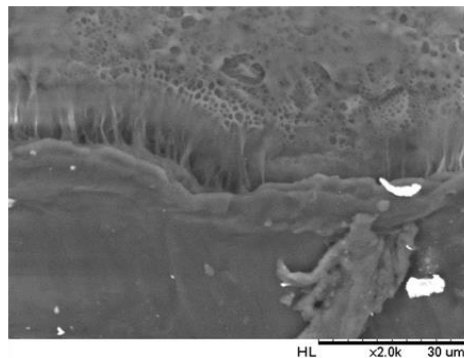
- Valorization of side-products from *paper and pulp industry*: Nanocellulose (CNW/MFC) and lignin products
- *Paper products* with engineering properties (bio-based barrier coatings, surface properties, high-strength papers, functional papers)
- Rheology, Processing and characterization of *bio-based nanocomposites* (PHB, PLA)
- *Organic nanoparticles* with encapsulation & controlled release



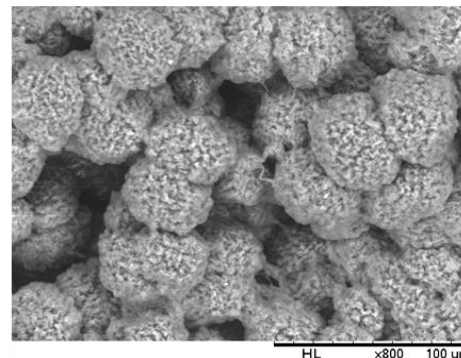
Surface-modified MFC



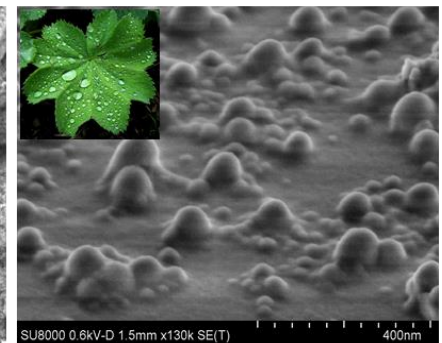
Extruded PLA + MFC



PHB microspheres



SMI/oil nanoparticle paper coating



Contact us...

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