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Research scope of the Thermochemical Process Group at the Latvian State Institute of Wood Chemistry

Different thermochemical processes produce a vast array of biomass-based products from wood, lignin and other raw materials. LSIWC is equipped with **laboratory and pilot scale equipment** for performing **various pyrolysis processes**, including, catalytic and over-heated steam promoted, as well as hydrothermal carbonisation. Additionally, **qualitative and quantitative characterisation** of the obtained products is ensured. These processes can be integrated in a cascade biorefinery, and, depending on the process conditions, they provide such products as **bio-char, nanostructured carbon materials and pyrolysis liquids (bio-oil)**, which are a source of **valuable chemicals** (anhydrosugars, such as, levoglucosan, levoglucosenone, aldehydes, organic acids and phenol derivatives). The obtained carbon materials are also modified by **chemical or physical activation, and doping with nitrogen and metals**, to promote applications of biomass-based carbon materials for **catalysis**, as well as **energy conversion and storage**.

Thermochemical processes

Pyrolysis

- SLOW PYROLYSIS, CARBONISATION
- HIGH TEMPERATURE PYROLYSIS
- PYROLYSIS IN SUPERHEATED STEAM
- CATALYTIC PYROLYSIS
- FAST PYROLYSIS

Modification

- CHEMICAL ACTIVATION
- PHYSICAL ACTIVATION
- DOPING

Applications of biomass-based carbon materials:

- Electrochemical devices – batteries, fuel cells, supercapacitors
- Bio-electrodes for hydrolysis to obtain hydrogen
- Activated carbon as a sorbent
- Support for heterogeneous catalysts
- Soil amendment and carbon sequestration

Liquid pyrolysis products as a source of green chemicals:

- Anhydrosugars – levoglucosan, levoglucosenone and others
- Aldehydes, incl., furan derivatives
- Organic acids, such as, levulinic acid
- Aromatic compounds (phenolic aldehydes and phenolcarboxylic acids, e.g., vanillin and vanillic acid)

We produce carbons on g/kg scale:

- **Porous materials with S_{BET} >2000 m^2/g**
- **Hard carbon materials**
- **Biochar for multipurpose applications**

Benefits of biomass-based carbon include feedstock availability, low cost, renewability and environmental friendliness. Biomass-based precursors have a hierarchical structure, which also contributes to the formation of the necessary porosity. Carbons are multifunctional materials for sorption, ion-exchange, complexing, electrochemical and catalytic applications.